Industry and Power

March 1953

CONTROL VALVES

Special 40 page Report

Report covers detailed information on design, characteristics and application of control valves and positioners to assist men responsible for Engineered Plant Services in selecting the proper unit 67

Emergency Power on Call

No need for automatic stand-by controls when this remote switching is used 63

Spreader Stokers

Spreader stokers have their limitations, but E. C. Miller tells how their versatility makes them increasingly popular.. 107

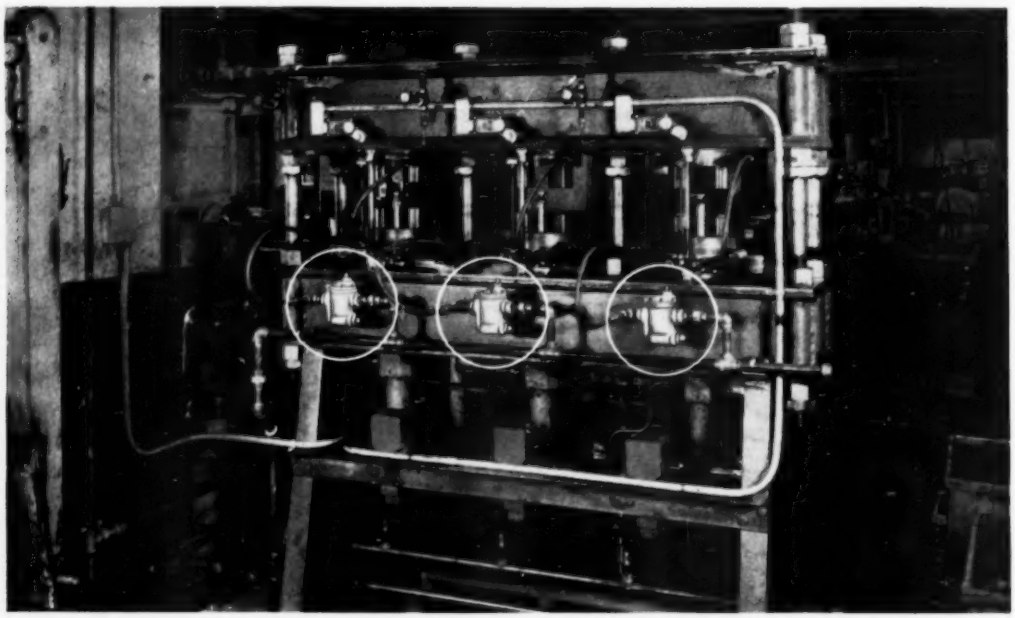
Continuous Blowdown Design 111

Automatic Combustion Control 114

Cables for Network 121

— for engineered plant services

Relies on Armstrong "Unit Trapping" to maintain molding press temperatures within ±5°F.



Uniform molding temperatures reduce leather cup rejects by 40%!

MANY a plant has accepted erratic temperatures of steam heated equipment as a necessary evil. Not so at Albert Trostel & Sons Company, Milwaukee, manufacturers of molded synthetic rubber and leather parts. They unhesitatingly replaced an electrically heated molding press, that varied in temperature as much as 30°F., with a steam heated press because they knew from previous experience that Armstrong Unit Trapping would give them uniform temperature control. Their confidence was not misplaced. An indivdual Armstrong steam trap on each station of the press keeps temperatures uniform within plus or minus 5°F. Molded leather cup rejects have been reduced by 40% and production greatly increased.

The benefits of Armstrong Unit Trapping are easy to understand. First, if you drain more than one unit with a single trap, any variation in pressure between the units will cause condensate and air from a higher pressure unit to block drainage from a slightly lower pressure unit or section. With an individual trap on each unit this cannot happen. Secondly, Armstrong traps discharge condensate and air as fast as they accumulate so that every unit is always full of hot dry steam and, hence, at maximum temperature.

Let your local Armstrong Representative look over your condensate drainage system—he sells Armstrong traps under a *satisfaction-or-your-money-back guarantee.* Call him or write:

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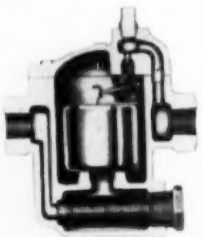
BONUS VALUE



Built-in Strainer Trap Saves Money, Maintenance

Small traps need strainer protection against dirt and scale. Howard Knoller, V.P. & Plant Engineer of Albert Trostel & Sons Company, uses and likes Armstrong No. 880 traps with built-in strainers because: they cost less than a trap plus separate strainer; save fittings and installation labor, and the strainer can be cleaned without removing trap or shutting off steam.

You Always Get Greater Efficiency When You Use Armstrong Unit Trapping

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STEAM TRAP BOOK
Gives Complete Data

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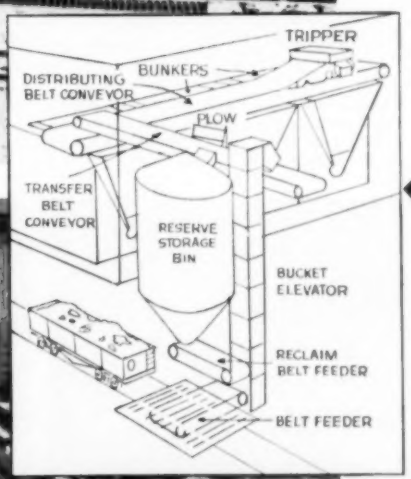
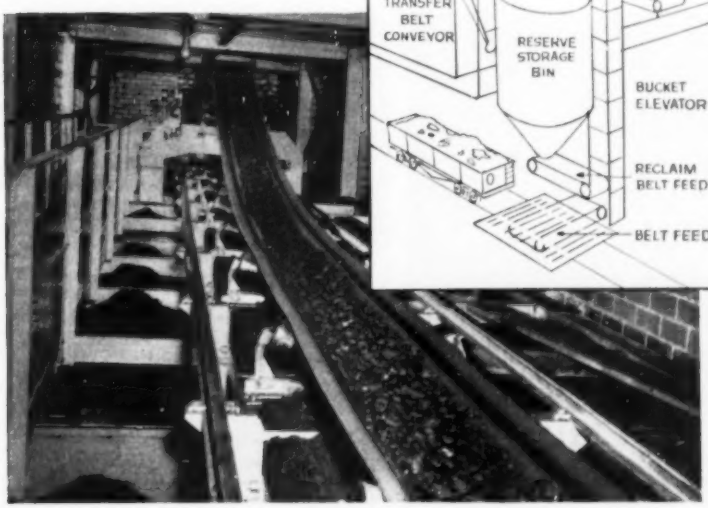
Title .....

Maximum power plant efficiency starts with low-cost coal handling





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As boilers and generating equipment approach their efficiency limits, the one large-scale method to reduce cost per kwh is improved coal handling. That's why Link-Belt's broad engineering experience and complete line of equipment are so important.

Whether your requirements are large or small, Link-Belt will design and build a coal handling system to give you the highest efficiency and greatest economy. Our engineers can choose from all types and sizes of equipment for unloading, storing, handling and weighing your coal. And Link-Belt will assume complete responsibility for the entire installation — from planning to erection.

You can see the latest in equipment and system layouts in Link-Belt Book 2410. Ask the engineer in the Link-Belt office near you for a copy. He'll also be glad to show you how this modern planning can cut costs on your particular handling problem.

At A. V. Roe Canada Limited, Malton, Ont., one of Canada's biggest industrial plants, coal moves from track hopper on belt feeder to bucket elevator to transfer belt conveyor. Manually operated plow diverts coal from transfer belt conveyor to reserve storage or allows it to be carried to distributing belt conveyor where tripper discharges it to various bunkers. A second belt feeder reclaims coal from reserve storage bin to bucket elevator.

13,000

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COAL HANDLING EQUIPMENT

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities.

Only B. F. Goodrich makes the grommet belts that cut costs 20 to 50%!

Save 3 ways! Investigate today! Write or mail coupon

You save belt costs because belts last longer, save production costs because machines keep running with fewer interruptions, save maintenance costs because they need less attention.

Patented grommet belts by B. F. Goodrich represent the only basic change since invention of the V belt. Belts last 20 to 50 per cent longer, depending on service. (The more severe the service, the greater the increase over ordinary belts.) Grommet belts have more rubber; they're more flexible, give better grip, less slip.

What is a grommet?

A grommet is like a giant cable except that it's *endless*—a cord loop built up by winding heavy cord on itself. There is no overlapping cord *section* as in all ordinary belts. Most belt failures occur in these sections where cords overlap!

All cords put to work

Each of the two grommets and every part of a grommet carry their share of the load. In ordinary belts under high tension the center cords "dish" because tension is greater near the driving faces. Dished cords are doing less work, not pulling their share. Grommet belts have no center cords, there is no dishing—therefore much more strength in proportion to cord volume—and less stretch. Grommet belts stretch, on an average, only about one-third as much as ordinary belts.

Better grip, less slip

Grommet belts have more rubber in relation to belt size. Without any stiff overlap, they're more flexible, grip pulleys better. Size for size, grommet belts give ⅓ more gripping power, pull heavier loads with a higher safety factor. Because there is less slip, there is also less surface wear.

Send for proof

Send the coupon for a set of reports telling users' experiences and showing actual installations where grommet belts outlasted all others. Some typical cases:

"... within a few days ordinary belts had stretched ... After six months of 24-hour-a-day service BFG grommet belts haven't stretched at all ..."

"Ordinary belts lasted only 5 or 6 weeks ... B. F. Goodrich grommet belts are in their sixth month of service ..."

"Previous belts suffered from shock loads, wore out fast ... BFG grommet belts have been in service 2 years with no shut-downs..."

There are hundreds of cases like these.

They cost no more

BFG grommet belts cost not one cent more than others. The savings they make for you are clear profit. They are made in C, D and E sections. They are patented by B. F. Goodrich. No other V belt is a grommet belt (U. S. Patent No. 2,233,294).

Write, send the coupon or see your B. F. Goodrich distributor. (He will show you his "X-ray" belt that shows the grommet construction clearly.)

Grommet V-Belts BY

B.F.Goodrich

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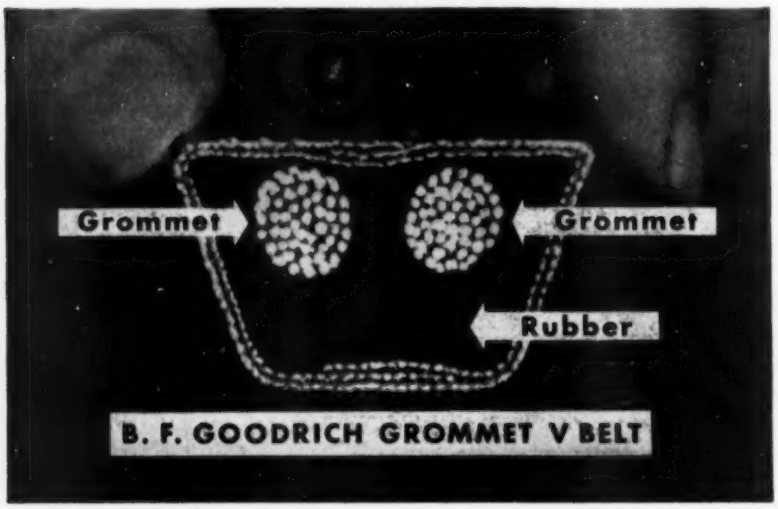

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Dept. IP-3
Akron, Ohio

☐ Send set of reports telling users' experiences and showing actual installations proving that B. F. Goodrich grommet belts outlast all others.

☐ Have distributor show me the "X-ray" belt that shows how B. F. Goodrich grommet belts are made.

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Industry and Power

VOLUME 64 **March 1953** NUMBER 3

F E A T U R E A R T I C L E S

Emergency Power on Call 63
Walter Rudolph

Application of Spreader Stokers 107
E. C. Miller, Research Engineer, Riley Stoker Corp.

Continuous Blowdown Systems 111
C. B. Houser, Sales Project Engineer, Cochrane Corp.

How to Apply Belting for Cotton Gins 113
Francis A. Westbrook

Automatic Combustion Control for Gas Burners 114
Wm. H. Pugsley, V-P, Field Research, The Hays Corp.

Cables for Networks and Aerial Service 121

SPECIAL REPORT

Control Valves and Positioners — Introduction 67
Chester S. Beard, Gas Engineer, Ebasco Services, Inc.

Flow Characteristics 68

Valve Body Design 70

Mechanical Features of the Valve Body 77

Actuator Design 82

Electrical Actuation 87

Measurement of Variables 90

Viscosity of Flowing Fluids 100

Reference Data 103

Bibliography and Acknowledgments 106

Cover Illustration—Powers Regulator Co. 124

D E P A R T M E N T S

Acorns of Science 6
New Equipment 8
Handbook 121
Spot News 124
News of Men 136
Readers' Guide 149
Book Reviews 158
Meetings 160
New Bulletins 162
Available Reprints 177
Classified Advertising 177
Advertisers' Index 178

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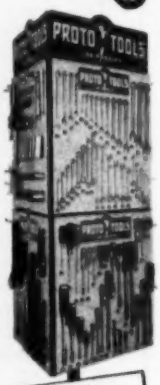

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Prospecting for Transistors

● First and heaviest impact by transistors on some companies may not be their value as amplifiers but in processing or recovering germanium for making them. Also used in crystal rectifiers and other electrical items, germanium is as valuable as gold. It has been found in zinc ore, copper mines, flue dust from coal producer gas, and bituminous coal seams.

Contradictory Phenomena

● Big factor in lubricant deterioration is self-oxidation, hastened by heat. But a Department of Commerce report describes work on, and presents theories of, chemical reactions that cause certain pro-oxidants to intensify inhibiting effects of some anti-oxidants. Fortunately, anti-oxidants concerned are types added for other characteristics such as proper viscosity and boiling point but, when used alone, are weak inhibitors. Pro-oxidants, such as lithium soaps which improve low temperature and high pressure properties, would hasten deterioration. Used together, inhibiting effect of the anti-oxidants, which should be weakened, becomes very strong.

Gas Problems Wanted

● The microwave spectrograph, one of the newer research tools, has been made available for solving industrial problems involving gases by the Illinois Institute of Technology on a contract basis. Instead of light, radio waves of about 1 cm wave length are used in the absorption type instrument. It can identify certain gases, find their concentration in mixtures, give information about molecular and atomic structures, and follow rapid chemical reactions involving gases.

Seeing by Sound

● Patent No. 2,614,645 discloses means useful in following progress of a chemical reaction within a sealed chamber. This is accomplished by a novel combination of devices for detection of the sonic vibrations set up within the sealed reaction chamber by occurance of the reaction.

Dielectric Characteristics

● Impregnated glass fiber paper has been developed at the Naval Research Laboratory to produce a new dielectric material that would make possible a temperature stable capacitor. Possibly even more interesting, the report shows that, to a certain extent, stability of the new material can be determined by the way each component (glass, glass fiber and impregnant) changes electrical characteristics with change in temperature. Also included are accurate data on electrical characteristics such as loss factor and dielectric constant for each component and for the material itself.

Compensated Thermocouple

● Patent No. 2,612,779 covers a compensated thermocouple circuit for measuring temperature of a current carrying conductor. The circuit, including a meter, has first and second dissimilar thermocouple wires connected to the meter and to each other (for the hot junction) on the surface of the conductor. A third wire of the same material as the first is connected at the hot junction on the opposite side of the second wire in the direction of current flow at a predetermined point to form a balanced resistance bridge that cancels any potential impressed between principal thermocouple wires.

Better Plastics?

● By virtue of a unique technique, Hercules Powder Company expects to bring cost of isophthalic acid, in its low melting, easily processed ester, down to compete with phthalic acid in full scale operation. Advantages of the material, now in pilot plant production, include plasticizers with improved low temperature efficiency and lower volatility, tougher longer lasting protective coatings based on oil modified alkyd resins, and improved toughness in laminating resins.

FOR SAFER CONTROL ---------- OF HARD-TO-HANDLE FLUIDS

CRANE Packless Diaphragm Valves

Now Available in *New* Materials

WORKING PRESSURES—up to 150 pounds. Water, air, oil, or gas, 180°F. maximum temperature, depending on valve size and materials.

You asked for it—and now Crane gives you this outstanding Diaphragm Valve in a new wide choice of body, disc insert, and diaphragm materials—in unlined or lined patterns. Whichever is specified, Crane design gives you important advantages including—long diaphragm life . . . positive shut-off in case of diaphragm failure . . . less resistance to flow with minimum pressure drop . . . easy operation . . . simplified maintenance at lowest upkeep cost.

Full specification data is in your new Crane 53 Catalog—or ask your Crane Representative.

SCREWED ENDS, UNLINED Sizes ½ to 2 in.
Brass, Cast Iron, Aluminum, or 18-8 Mo body and disc. Furnished with neoprene, Buna N, and natural rubber diaphragm and disc insert.

FLANGED ENDS, UNLINED Sizes ½ to 6 in.
Cast Iron, Aluminum, or 18-8 Mo body and disc. Furnished with neoprene, Buna N, and natural rubber diaphragm and disc insert.

FLANGED ENDS, LINED Sizes 1 to 6 in.
Cast Iron body only. Lined with neoprene or hard natural rubber. Disc coated with neoprene or soft natural rubber.

Other body and disc materials, as well as linings, available on special order. Also sliding stem valves for automatic operators of all types.

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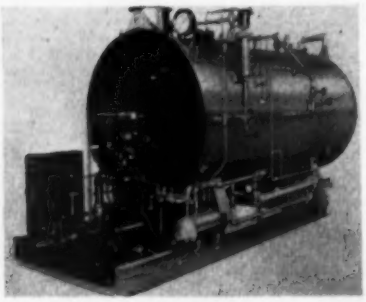
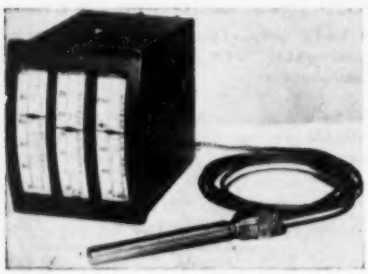


Quick conversion offers maximum fuel flexibility

C10 Fast changeover is the principle feature of a combination gas and oil fired boiler manufactured by Cleaver-Brooks Co. The design permits operation on gas with the oil burner in place. Changing fuels therefore involves only the setting of a selector switch and fuel supply valves. No mechanical or electrical changes are required.

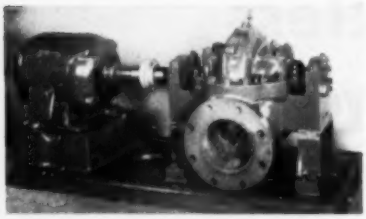
Bucket elevator requires minimum space

C11 Compact size, to permit use in chemical feeder rooms where minimum floor space is a consideration, is an important feature of the model BES-77 bucket elevator developed by Omega Machine Co. The unit is driven by a 1½ hp gearhead motor. Feed buckets travel on pintle chain from boot to head at a maximum delivery of 200 cfh.



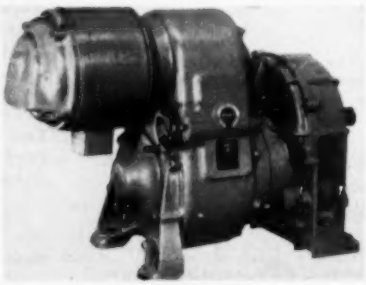
Indicating instruments feature interchangeability of parts

C12 Interchangeability of all parts is provided in the design of a series of vertical scale indicating instruments manufactured by The Dickson Co. The units, known as Mindicators, can be used on control panel boards as receivers and as direct reading gages and thermometers. Instruments designed as receivers operate on transmitted pressure of 3 to 15 psi. Temperature ranges are from -200 to 1000 F, and pressure gages are available from 0 to 15 psi up to 0 to 1000 psi. Construction is described in available literature.



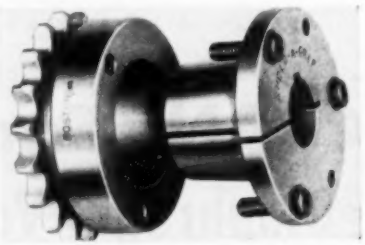
Pumps feature compact design

C13 Compactness is listed among the design improvements of the Fig. 3405 series, single stage, double suction centrifugal pumps, manufactured by Gould Pumps, Inc. Another feature is the design of shaft sleeves to permit changing direction of impeller rotation in the field without additional parts. Units can be supplied with electric motors, belt, or steam turbine drives. Capacities are 200 to 6400 gpm, with heads to 260 ft. Construction is described in a bulletin.



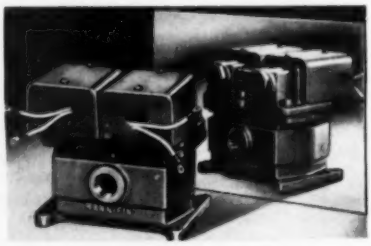
Variable speed drives are for heavy duty service

C14 Double reduction, variable speed drives have been developed by Sterling Electric Motors, Inc. for heavy duty service in low speed ranges. The units, known as Speed-Trol type KFEB, are offered in 20 and 25 hp capacities with speed variations of 2:1, 3:1, and 4:1. Maximum speeds range from 176 to 42 rpm for the 20 hp model, and 176 to 64 rpm for the 25 hp unit. Special designs such as drip-proof, splash-proof, and totally enclosed, fan-cooled types are available.



Split bushings eliminate boring of stock sprockets

C15 Interchangeable split tapered bushings, manufactured by Boston Gear Works, are said to eliminate boring of stock sprockets to fit a particular shaft. The bushings, known as Shold-a-Grip, are said to grip both the sprocket and shaft with the equivalent of a press fit, even on shafts which are undersized as much as .005 in. Sizes from ½ to 2½ in. dia in steps of 1/16 in. are listed in available literature.



Valve eliminates repeating of mechanical presses

C16 Repeats caused by valve failure on mechanical presses, controlled by air-operated clutches and brakes, are made practically impossible by an air control valve developed by Hannifin Corp. Known as P-M BB-5, it consists of two 3-way valves in parallel. Since both valves must operate to start the press, failure of either one will stop the machine. It is offered in ¾ in. size for speeds of over 600 cycles per minute. Standard units are for 115, 230, or 460 v; 25, 50, or 60 c operation.

(Continued on page 12)

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Mounting pressures and temperatures in power generation and industrial processing call for Cast Steel Valves. For this increasing need, Jenkins offers a wide selection of patterns that have met the test of the toughest services throughout industry.

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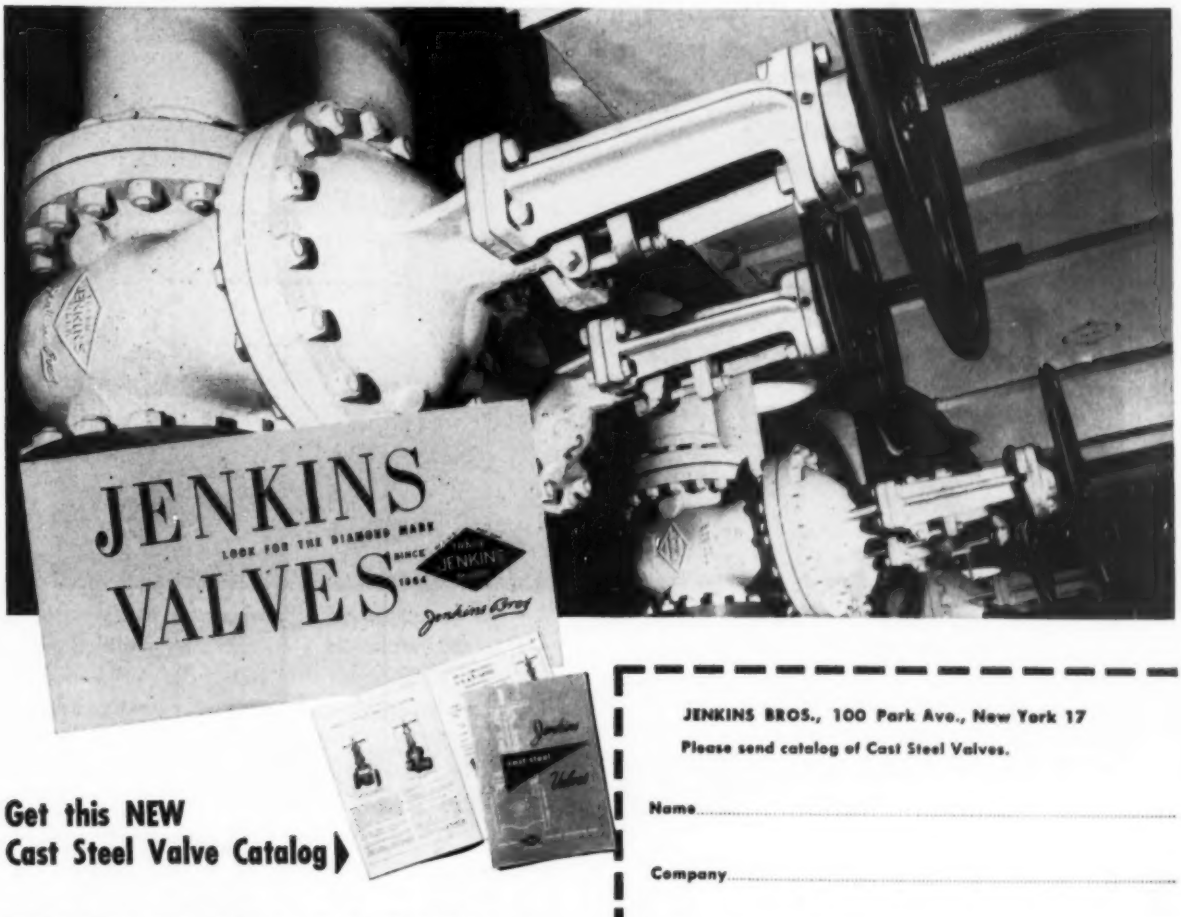

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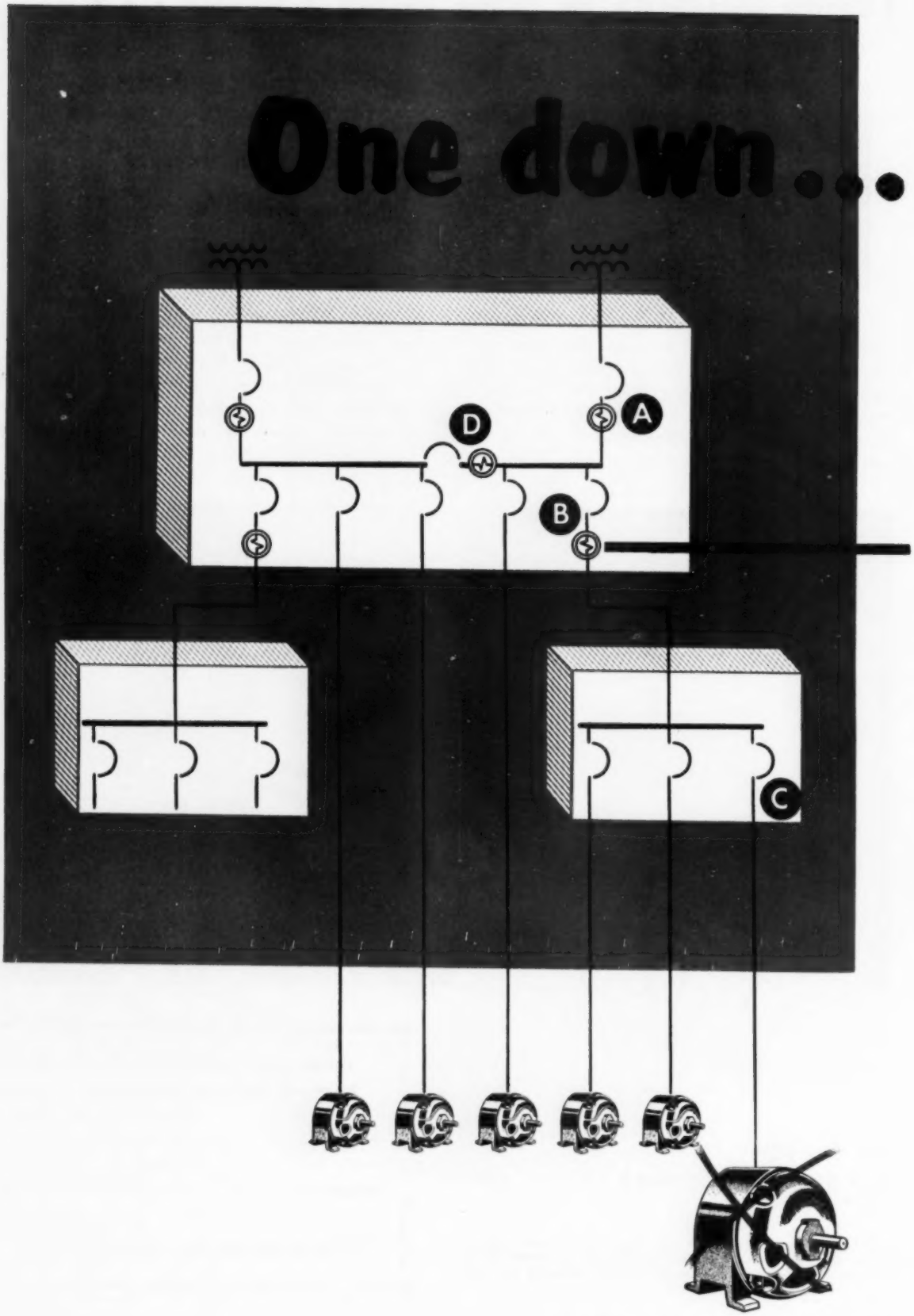

One down...
A
B
C
D

or shutdown?

Selective tripping on I-T-E Circuit Breakers isolates system faults, boosts system reliability

What selective tripping is

Selective tripping is the economical means for providing reliable electrical service with complete freedom from general interruption. With selective tripping, several circuit breakers may be used in series; yet on overcurrent or fault, *only* the faulted circuit is interrupted.

What it does

Consider the following cases for a typical low-voltage system:

Without selective tripping—the overloaded motor in the diagram at left could cause breakers C, B, D, and A to trip, shutting down a boiler, a plant, or an entire system. This *will* happen, if the system does not include circuit breakers equipped for selective tripping.

With selective tripping—only breaker C will trip. A motor saved, one circuit interrupted, while *the rest of the system continues to operate—unaffected.*

Consider I-T-E selective tripping for your system

In central stations, in manufacturing plants, in the processing industries—I-T-E selective tripping has saved in initial investment, boosted system reliability, and reduced breaker maintenance. If you're planning a new low-voltage switchboard application, investigate the advantages of direct-acting I-T-E trip devices.

I-T-E trip device is a compact circuit breaker component

Selective tripping in low-voltage systems is easily applied with I-T-E Circuit Breakers. The breakers are simply equipped with compact I-T-E *direct-acting dual-selective overcurrent trip devices.* No expensive current transformers, no relays, no added switchboard panels are required. The trip devices are fitted as an integral part of the breaker.

I-T-E

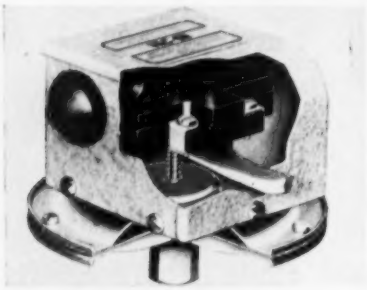
LOW-VOLTAGE SWITCHGEAR

I-T-E CIRCUIT BREAKER CO. • 19TH AND HAMILTON STS. • PHILADELPHIA 30, PA.

CANADIAN MFG. & SALES: EASTERN POWER DEVICES, LTD., TORONTO

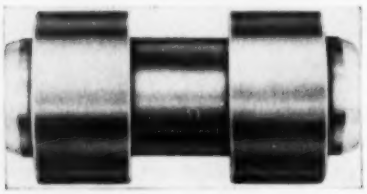
new equipment

(Continued from page 8)



Inexpensive vacuum switch serves as safety device

C17 Jaycon Associates has developed an inexpensive vacuum switch to be used with equipment using suction-delivered lubricant, fuel, water or similar liquid. Known as Vac-on, it shuts off power supply on electric motors, or the spark system on gasoline engines, when the liquid supply runs dry. It can be used on motors up to 2 hp on a-c or ½ hp on d-c supply. The unit also serves as a warning control where operating conditions depend on vacuum.



Coupling permits rapid disassembling

C18 Sier-Bath Gear and Pump Co. has designed a spacer type gear coupling which can be quickly disconnected without wrenches or special tools. It consists of two flexible hubs and a center unit with teeth designed to mate with two sleeves in a spline fit. Sizes for maximum bores from 1¼ to 3⅛ in. for capacities from 4 to 80 hp per 100 rpm are listed in a data sheet.

Conductor system uses aluminum construction

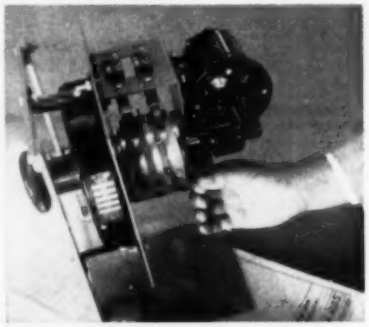
C20 Aluminum third-rail conductor systems with safety enclosures for powering moving cranes, bridges, and allied materials handling equipment have been developed by The Electric Service Manufacturing Co. Known as the Keystone system, it offers a design capacity of 1000 amp in a conductor weighing 1/20 that of steel rail-copper booster combinations. It can be used for control and medium amperage conductors, and can be applied in parallel to handle currents two or more times normal rating. The absence of arcing permits safe operation at voltages as high as 4160 v.

TO REQUEST ADDITIONAL FREE DATA

Insert "key" numbers on return post card found on page 147. Our Reader's Service Department will handle your request promptly

Control valves incorporate interchangeable seat rings

C21 Interchangeable seat rings, used in a double seated diaphragm control valve designed by Leslie Co., are assembled without sealing compound and can be replaced without removing the valve body from the line. Self-aligning top and bottom guides also are easily removed. According to the manufacturer, these guides cannot bind with uneven bolt tightening. Units are available in sizes from 1½ to 10 in. Operation is discussed in a 12-page bulletin.



Rheostat features accessibility for inspection and service

C22 Ease of installation and maintenance are factors considered in the design of a motor operated field rheostat, according to the manufacturer, Westinghouse Electric Corp. The unit, called type RK, is used to adjust speed of d-c motors up to 200 hp and voltages of generators up to 300 kw. Cam-operated switches are adjustable over a 360 deg range, and are available for 15, 45, and 90 deg travel. Gear ratios can be supplied to permit full rheostat travel in from either 5 to 15, or 15 to 45 sec.

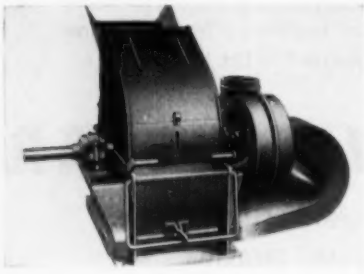
Packing combines properties of leather and rubber

C23 Rubber impregnated leather packing, developed by E. F. Houghton & Co., is described as combining the longer life and lower friction of leather with the non-porosity, high resilience and heat resistance of synthetic rubber. A special process combines the fibers of the leather and the synthetic rubber to form a homogenous product. The packing, known as VIM 1243 type 3, is produced in sizes from ⅞ to 6 in. OD.

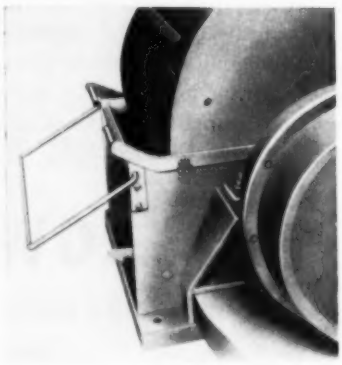
(Continued on page 16)

Hammer mill provides quick screen change

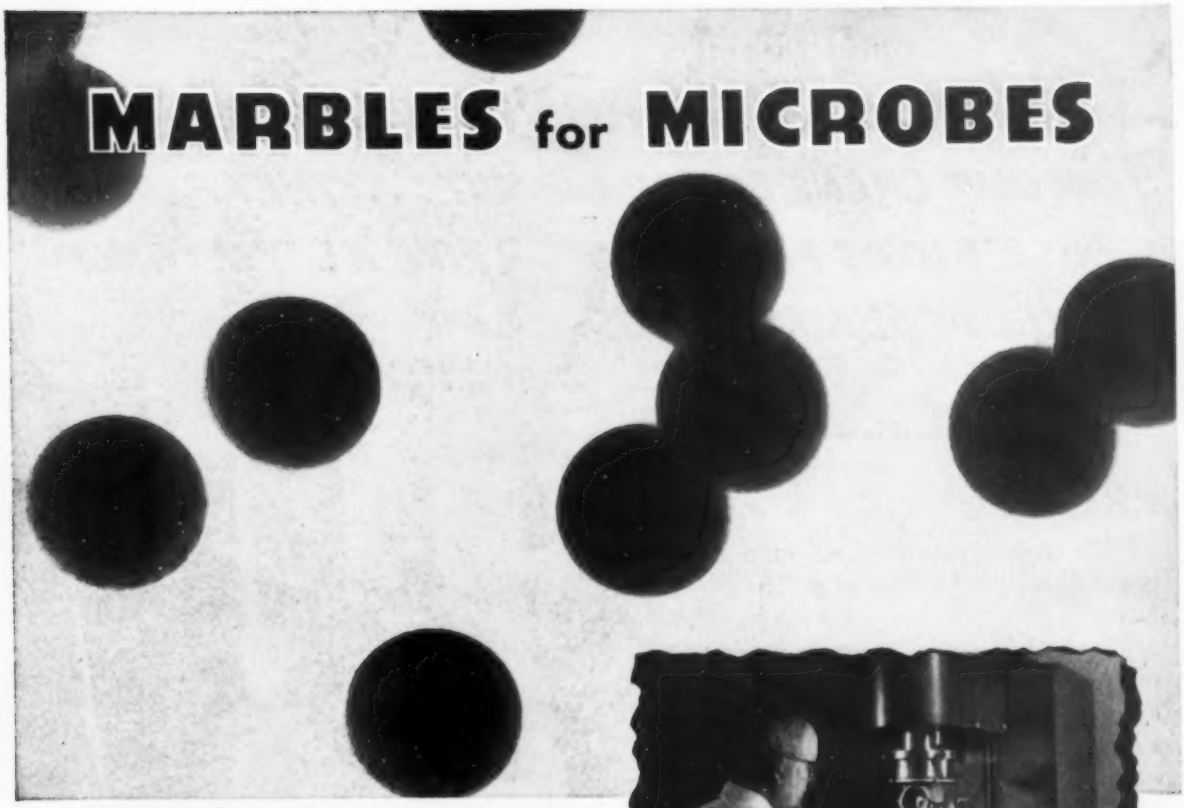
C19 Screen replacement without stopping operation or opening the cover is possible with a quick-screen-change hammer mill developed by Schutte Pulverizer Co. A lever lock is tripped and a wing nut is loosened to release the hand guard. The screen, which slides within leak-proof grooves, is then withdrawn and replaced without stopping the mill or opening the cover. The guard provides protection from the whirling hammers.



Where varying materials and grist sizes require frequent screen changing, the unit is said to be particularly advantageous in saving time and power. Sizes ranging from 20 to 125 hp are available in belt-driven and direct-connected models. Details of construction and operation are described in an available bulletin.



MARBLES for MICROBES



Above—100,000X enlargement of latex spheres used to calibrate electron microscope in Nalco Laboratories. Actual diameter of spheres is 0.25 microns—.00000975 inches! *Right*—Inserting specimen holder in vacuum chamber of Nalco electron microscope.

. . . How they assist research toward better Water Treatment

PERHAPS even too small to make good marbles for microbes, these tiny spheres help Nalco Scientists in their investigations of the microscopic realms of matter only recently made visible to the human eye by the electron microscope.

Use of the electron microscope in water treatment research is significant because it typifies the continuing efforts of the entire Nalco organization to keep the Nalco System representative of the first and best in all phases of modern industrial water treatment.

If you are not already participating in the economy and efficiency of the Nalco System in your plant, write for details on real water treatment security today.

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THE Nalco®
SYSTEM . . . Serving Industry through Practical Applied Science

Nalco WATER TECHS

New reprint of A.S.M.E. Paper No. 52-A-30: *Experimental Studies of Boiler Tube Metal Temperatures: Effect of Heat Transfer Rate and Deposit Thickness*, gives technical data on high-heat-transfer-rate effects (140,000 to 300,000 Btu/sq. ft./hr.) at pressures from 250 to 2500 p.s.i. 16 pages, with tables and diagrams. Author: C. Jacklin, Director, Engineering Research, National Aluminate Corporation.

Your Copy Free Upon Request

"WE TRIED FUSETRON DUAL-ELEMENT FUSES ON OUR CRANE MOTOR CIRCUITS . . . THEY REDUCED FUSE BLOWS FROM FOUR OR FIVE A DAY TO ONLY THREE IN SEVEN MONTHS"

Chas. A. Gardner, *Chief Electrician,*
Nicholson Terminal & Dock
Ecorse, Detroit, Michigan

PROBLEM

"We have many overhead cranes that operate on 24 hour schedules. The severe service to which these cranes are put when loading and unloading ships throws a tough load on the motors. This was causing us a lot of grief due to fuses blowing 4 or 5 times a day. Each blow caused a shutdown that stopped work and made men idle.

SOLUTION

"In testing Fusetron fuses to see if they would help us, we selected a certain crane and inserted Fusetron fuses in that circuit for one 8 hour shift. At the end of the shift we would replace the Fusetron fuses with the ordinary renewable fuses we had formerly used. Then we compared the down time of the crane due to fuse blows.

"To be sure the fuse blows weren't due to the operator, we changed around and would run the Fusetron fuses on two shifts and the old fuses on one.

"The results, however, always came out the same. The Fusetron fuses would stand up under the hard service — and the ordinary fuses would not.

"As a result of these tests we changed all fuses on our crane circuits to Fusetron fuses.

"That was last October, seven months ago, and to date we have had only 3 shutdowns of our cranes due to fuses blowing."

Don't Risk Losses

One **needless** shutdown . . .
One **lost** motor . . .
One **destroyed** switch or panel
One **burned out** solenoid . . .

May cost you far more than replacing every ordinary fuse with a Fusetron dual-element Fuse.

FUSETRON dual-element FUSES Protect Production *10* Ways

1 *Protect against short-circuits.

2 Protect against needless blows caused by harmless overloads.

3 Protect against needless blows caused by excessive heating—lesser resistance results in cooler operation.

4 Provide thermal protection—for panels and switches against damage from heating due to poor contact.

5 Protect motors against burnout from overloading.

6 Protect motors against burnout due to single phasing.

7 Give DOUBLE burnout protection to large motors — without extra cost.

8 Make protection of small motors simple and inexpensive.

9 Protect against waste of space and money — permit use of proper size switches and panels.

10 Protect coils, transformers and solenoids against burnout.

*Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York.

HERE'S WHY...

A fuse link combined with a thermal cutout — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to same dimensions as ordinary fuses, FUSETRON FUSES fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

FUSETRON is a trade mark of the Bussmann Mfg. Co.

Bussmann Mfg. Co., University at Jefferson, St. Louis 7, Mo. (Division of McGraw Electric Co.)

Please send me complete facts about FUSETRON dual-element Fuses.

Name _____

Title _____

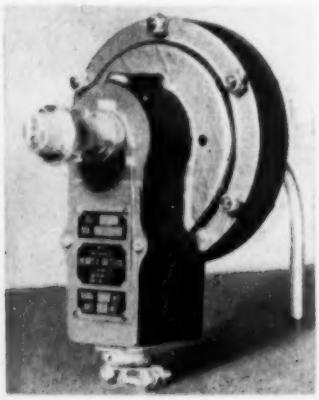
Company _____

Address _____

City & Zone _____ State _____ 353

new equipment

(Continued from page 12)



Control is designed for low pressures

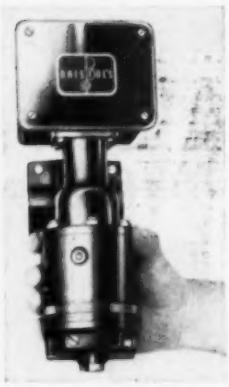
C24 Design improvements of sensitive static pressure controls, by The Henry G. Dietz Co., include a diaphragm which allows operation at high or low temperatures over extended time periods. Known as Cat. 101P, they are for use on very low pressures where regulation is required in inches of water. An available data sheet lists ratings from 0 to 20 in. water with range adjustment and with fixed differentials from .2 to 2 in. water. Power requirements are 10 amp at 125 v or 5 amp at 250 v, a-c.

Belts feature all rayon fabric

C25 Rubber transmission belts with all rayon fabric, developed by the B. F. Goodrich Co., are said to provide greater strength and better flexibility than cotton fabric belts with the same number of plies. Recommended uses for the belts, known as Drivesall, include medium duty drives on fans, compressors, pumps, machine tools, crushers, and mills.

Gasket makes motor control lint-tight

C26 Combination a-c motor starters are being made lint-tight by an NEMA 1-A enclosure developed by General Electric Company's Control Dept. It features an oil resistant rubber gasket which is pre-formed to fit over the edge of the case. The reset button also is gasketed.



Pneumatic transmitter features miniature size

C27 For measuring and transmitting readings to recording, indicating and controlling receivers, The Bristol Co. has developed a miniature pneumatic transmitter known as series 650. The unit can be used for temperature, pressure, vacuum, differential pressure and liquid level measurements. Transmission is by air pressure between 3 and 155 psi. Mounting can be in any position or location.

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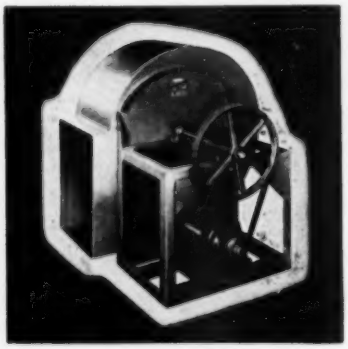
Insert "key" numbers on return post card found on page 147. Our Reader's Service Department will handle your request promptly

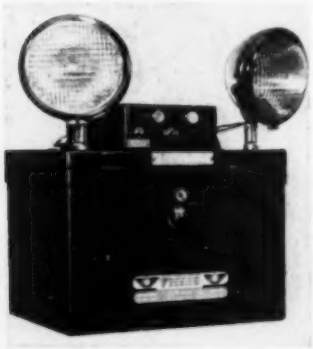


Utility blower incorporates adjustable motor pulley

C28 For variations in speed, an adjustable motor pulley is used in belt-drive utility blowers developed by Hartzell Propeller Fan Co. The units, in sizes from 9 to 30 in., are available with either clockwise or counter-clockwise rotation. Wheels are dynamically balanced to eliminate vibration and insure quiet operation.

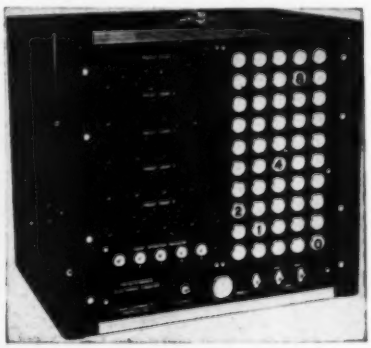
Fuel oil additive prevents filter clogging

C29 Screen and filter clogging are prevented by a fuel oil additive developed by Monsanto Chemical Co. Known as Santolene H, it is said to prevent clogging by: inhibiting formation of fuel oil sludge and sediment; preventing deposition of existing sludge and sediment; and by sharply reducing rusting. Recent tests on diesel engine operation indicate that benefits result without harmful effects to engine operation or deposits. Technical information is contained in a bulletin.



Unit automatically provides emergency light

C30 In case of power failure, the model E emergency lighting unit automatically provides up to 10 hr of illumination. The unit, powered by storage battery, incorporates a charger to automatically maintain battery charge and a built-in hydrometer to indicate state of charge.



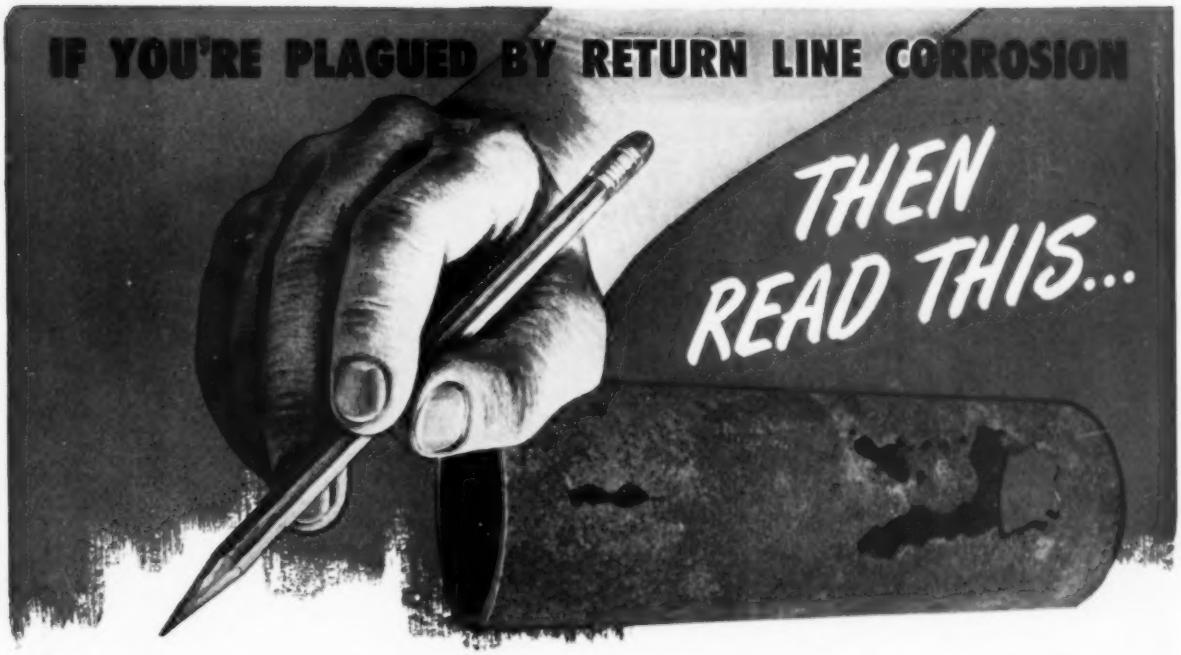
Counter employs cold cathode tubes

C31 Cold cathode tubes are used to provide long dependable life and high accuracy in high speed, predetermined electronic counters designed by Haledy Electronics Co. The units are able to operate at any selected count for application to machines or processes requiring exact measurement and control of frequency, quantity, length, time, velocity, and revolutions. Operation is on 115 v, 60 c supply.

Protective asphalt paint comes in powdered form

C32 Powdered asphalt paint, developed by the Asphalt Specialties Div. of Berry Asphalt Co., is said to offer high resistance to weather, smoke, fumes, and soil acids. Waste is reduced by packing in dry powder form, to be mixed with kerosene for brush or spray

(Continued on page 20)



As an engineer responsible for efficient, economical plant operation, you know only too well that corrosion of steam and condensate lines can send costs skyrocketing through pipe replacement, interrupted production, and increased labor and maintenance. Perhaps you, like many other engineers, have tried stop-gap methods to check the problem only to find them partially effective or far too costly.

Realizing the importance of this major industrial problem, Betz Laboratories has developed its patented filming amine treatment. Here, at last, is a simple, inexpensive, and practically 100% effective method of eliminating this costly and production-disrupting headache.

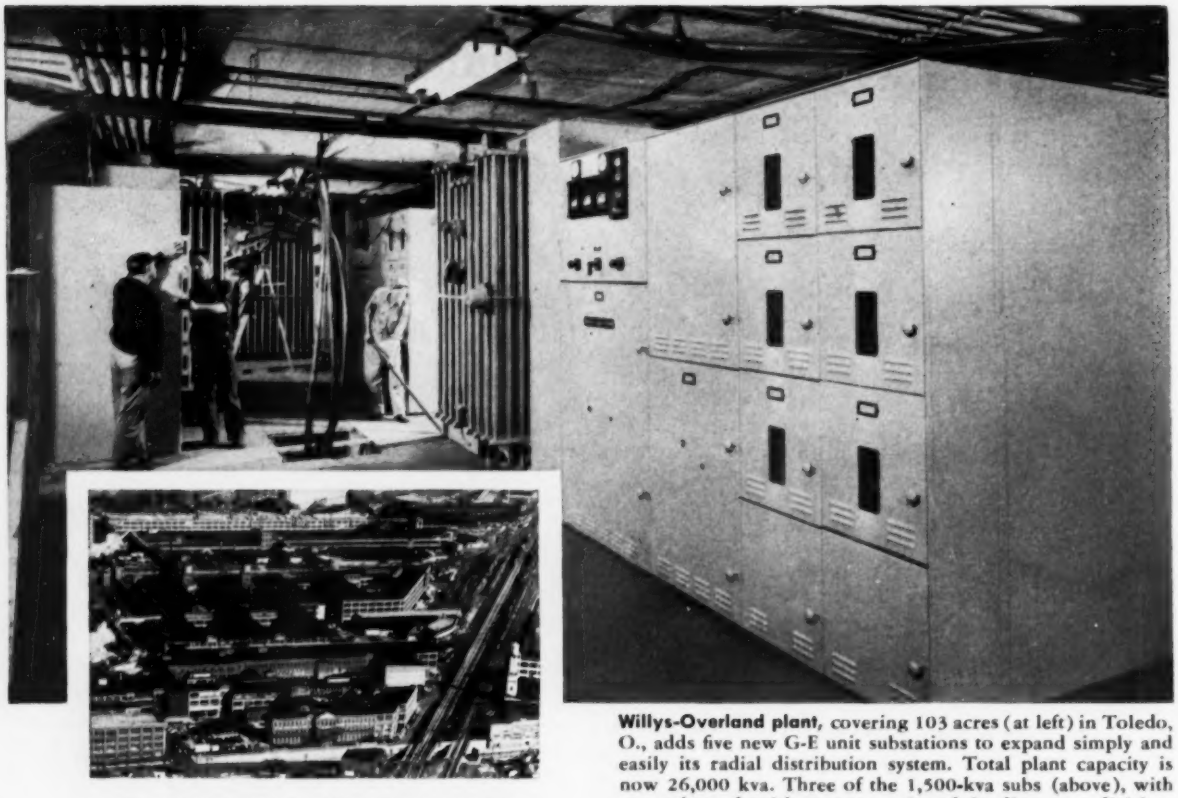
For example, a linoleum company, operating at 150 psi and producing 300,000 pounds of steam per day, employed sodium zeolite softening for a high bicarbonate raw water. The carbon dioxide content of the steam averaged 40 ppm. Continued maintenance was required due to failure of condensate lines from the steam kettles and unit heaters. After the filming amine treatment was applied, maintenance records showed an annual saving of approximately $8,000.00! And, a large part of this saving was obtained by eliminating weekend over-time work on pipe replacements.

Why not take the first step toward ridding your plant of corrosion *now?* Call in a Betz Engineer. Ask him to show you how Betz *Specialized* Water Conditioning Service can help you . . . quickly . . . economically . . . effectively. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

See for yourself how Betz filming amine treatment eliminates return line corrosion and reduces operating costs. Send for Technical Bulletin No. 124.

BETZ

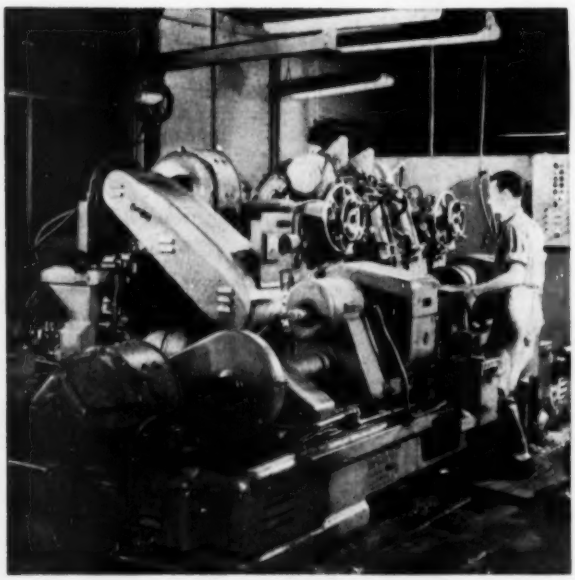
CONSULTANTS ON ALL WATER PROBLEMS



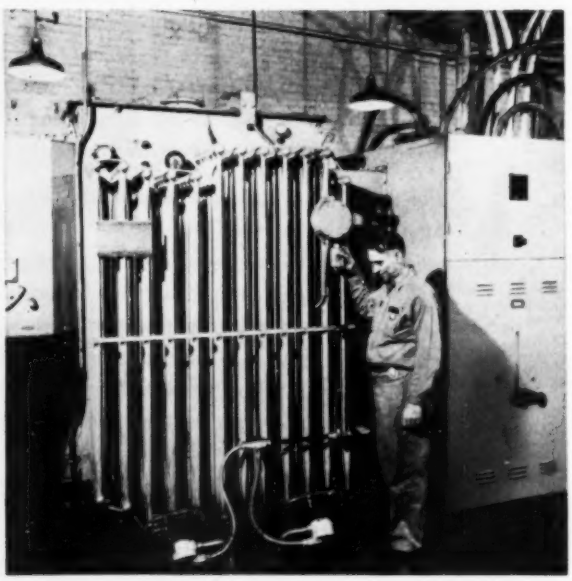
Willys-Overland plant, covering 103 acres (at left) in Toledo, O., adds five new G-E unit substations to expand simply and easily its radial distribution system. Total plant capacity is now 26,000 kva. Three of the 1,500-kva subs (above), with two others, furnish power to aircraft landing gear division.

AT WILLYS-OVERLAND—

One of nation's first load-center

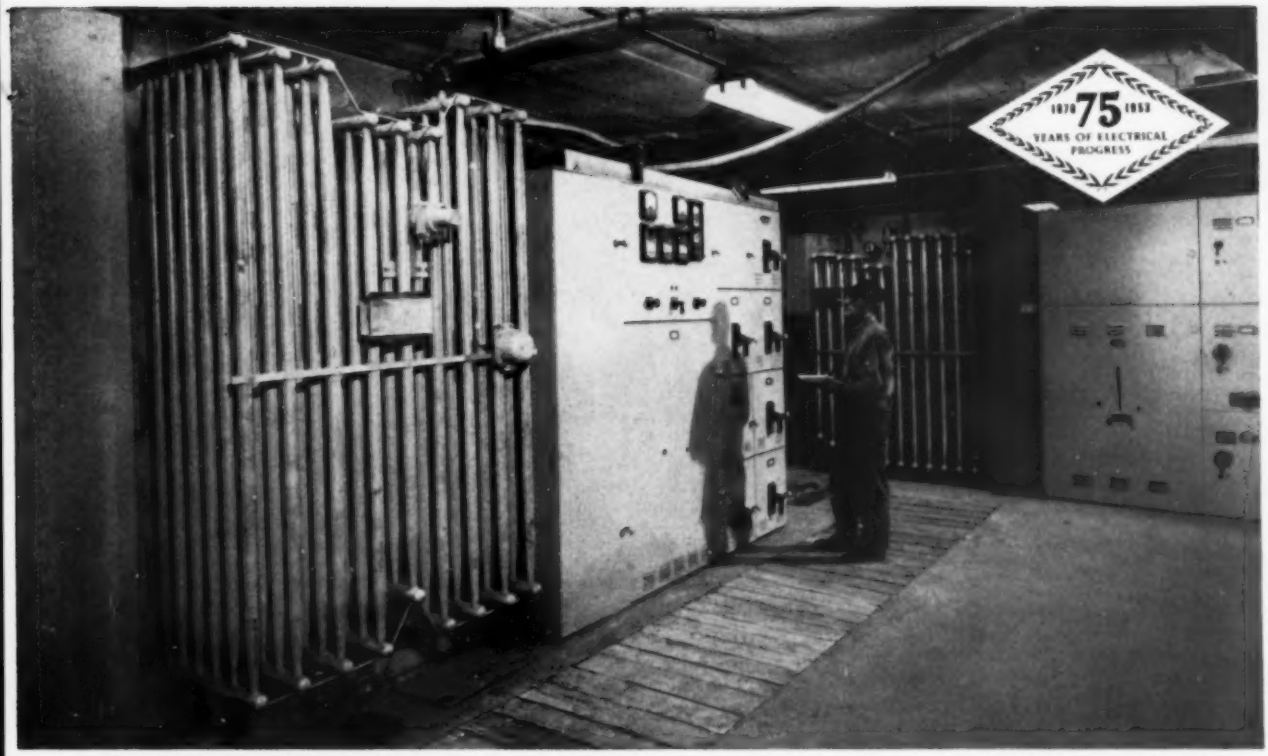


Grinder for crankshaft pin bearings is powered by a G-E unit substation, 4160-volt to 440-volt, which is located just beyond screen at left, adjacent to the load area.



Installed since 1945, when original system was expanded, G-E unit substation, with Pyranol* transformer, has been operating 24 hours a day, 5 days a week, with low maintenance cost.

*Reg. Trade-mark of General Electric Co.



New load-center units, are added to system which has operated for 13 years without power failure. Addition of new substations, like the two new 1,500-kva units above, does not alter over-all system, provides high degree of flexibility to handle shifts in plant loads. Unit subs, used as building blocks, can be placed wherever needed.

systems: Never a power failure!

G-E radial distribution system, installed in 1939, easily expanded to 26,000 KVA for increased plant loads

Flexibility in reliable power distribution for stepped-up production of Jeeps . . . quick, easy power expansion at little expense . . . low-cost maintenance with maximum safety. The Willys-Overland Company in Toledo found these advantages of its plant's radial distribution system multiplied when five new G-E 1,500-kva load-center substations were added recently for greater plant capacity.

During the past 13 years of trouble-free operation, engineers have had first-hand experience with the low cost, simplicity, and reliability of the radial system. A G-E outdoor unit substation furnishes plant power, steps down utility voltage to a usable 4,160 volts. Eighteen unit substations handle load requirements in more than two-score buildings on the 103-acre tract.

This installation is just one example of the way G-E engineering helps industry meet demands for more power. For further information, contact your G-E sales representative, or write for GEA-3592. General Electric Company, Schenectady 5, New York. 881-1

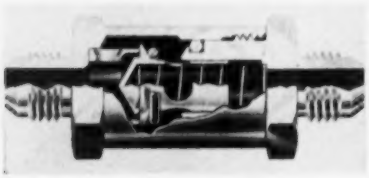
Outdoor G-E master unit substation, plus an indoor G-E station, furnishes power for 90 per cent of Willys-Overland capacity.

GENERAL ELECTRIC

new equipment

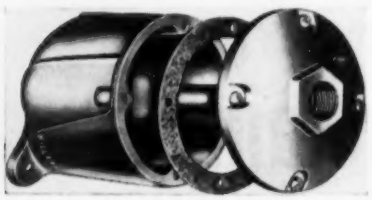
(Continued from page 16)

gun application. The paint, called Baromix, is available in four colors and is said to provide a permanent bond to metal, wood, concrete, or composition. It will not flow on vertical surfaces up to 325 F.



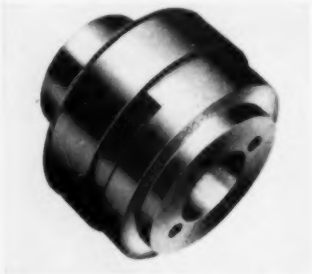
Valve serves dual purpose

C33 Many applications are listed by James-Pond-Clark for a valve developed to serve equally well as a flow limiter or as an automatic drain valve. The unit permits flow in one direction up to a predetermined rate while allowing unrestricted flow in the opposite direction. Units have male tube or pipe connections on the restricted flow discharge side, and either male or female connections on the inlet side.



Junction boxes are made of lightweight alloy

C34 Lightweight, non-rusting Alumalloy is used in the series VLJ vapor-tight junction boxes manufactured by Killark Electric Manufacturing Co. Diameter of all models is 4 in., while depths are 1⅝ to 3½ in. for ample wiring space. Units can be furnished with a blank cover, or with adapter plates designed to take vapor-proof lights or outlet box devices. Units are for conduit sizes to 1 in.



Coupling bolts to flywheel

C36 One hub is eliminated in the design of a modified type C coupling developed by Lovejoy Flexible Coupling Co. In place of the hub, three or more holes tapped into the remaining flange permit coupling to the center of a flywheel. In addition to saving the space normally required by a second hub, the unit is said to afford cost savings over standard flywheel couplings.

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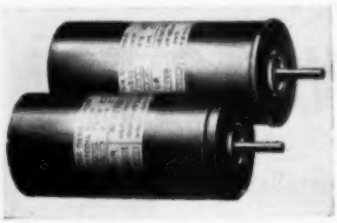
Insert "key" numbers on return post card found on page 147. Our Reader's Service Department will handle your request promptly



Miniature motor-generator for servo systems

C37 Transicoil Corp. announces the addition of a 400 c motor-generator to its line of miniature, precision components for servo systems. The unit weighs 4 oz and measures 0.9 in. dia. Phase voltage of the motor is 26 v with a maximum stall power of 2.6 w per phase and a minimum stall torque of 0.3 in-oz. Output of the generator is 0.34 v per 1000 rpm with excitation power of 2.0 w maximum.

Hanger provides constant support for high temperature piping

C38 Constant support that is mathematically perfect for all positions of travel for high temperature process and steam piping is supplied by the model R constant support hangers manufactured by Grinnell Co., Inc. An important feature of the design permits 10 per cent increase or decrease in load by field adjustment of a single bolt, without impairing the constancy. Three frame sizes provide maximum travel of 4, 8, and 12 in. to handle all loads from 48 to 9304 lb.

Plastic ducts for corrosion resistance

C39 Solid plastic, corrosion-proof fume ducts, hoods, and accessory equipment are being offered by Heil Process Equipment Corp. with glass reinforced construction. They are said to possess the strength of light metals, to be much lighter in weight, and to withstand operating temperatures in excess of 200 F. Available designs, sizes and data are outlined in two bulletins.

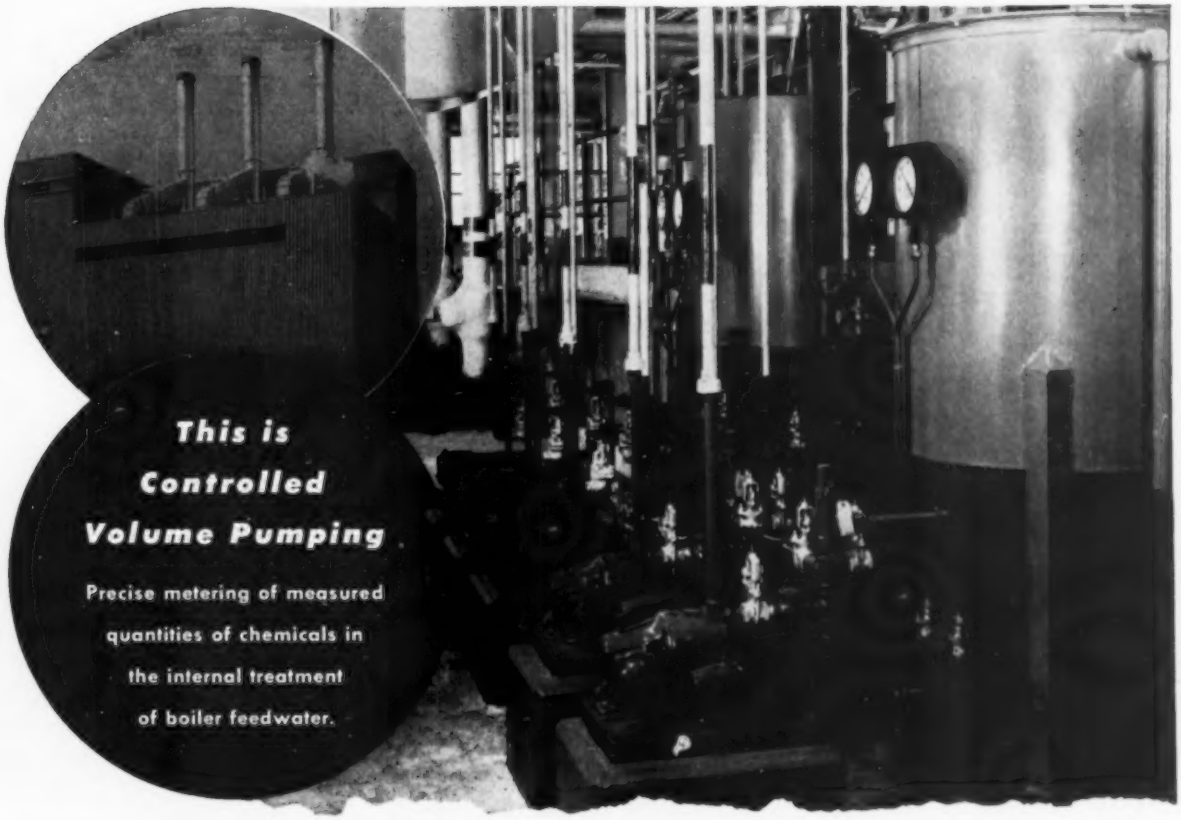
(Continued on page 24)

Platform reduces danger when loading and unloading tank cars

C35 To eliminate the hazard of working on curved tops of railroad tank cars during loading and unloading operations, Nichols Engineering Co. has designed a safety platform. The operator can perform all servicing operations from the grated deck of the platform without stepping onto the tank car top.

From the deck, the operator can turn the platform 360 degrees by means of a hand crank wheel, and can stop it over the tank car at any angle. One platform can service cars on either side.

Piping is supported by adjustable chains attached to overhead bracing. Liquid tight swivel joints, quick disconnect couplings, and variable positioning eliminate the necessity of spotting cars at a precise location. The platform piping leads through the supporting column to underground storage tanks, thus preventing waste caused by stuck valves, which often happens when unloading from the bottom of the car.



THESE MILTON ROY CONTROLLED VOLUME PUMPS DO THE JOB . . .

The modern Beloit, Wisconsin steam generating plant of Fairbanks, Morse & Co., manufacturers of diesel engines, locomotives, generators, pumps, motors and magnetos, is designed to handle heavy processing loads and plant heating. To help maintain the continuity of service so vital to power plant operation, company engineers placed emphasis on methods of preventing corrosion and other destructive conditions in the boiler feedwater system. Five Milton Roy Controlled Volume Simplex Pumps are employed to meter precise quantities of chemicals into the boiler feedwater: disodium phosphate for residual water hardness in the boiler drums; sodium sulphite for oxygen removal in the deaerator and feed lines; organics for prevention of precipitation in economizer and feed line; alkalene polyamide as anti-foam for reduction of surface tension; octadecylamine for steam and return line corrosion. Fairbanks, Morse & Co. specified Milton Roy Controlled Volume Pumps because of their metering accuracy, service dependability, positive and flexible control, low maintenance.

Boiler feedwater treatment is only one of many applications of Milton Roy Controlled Volume Pumps. They're also used in all forms of internal and external feed systems, including introduction of chemicals directly to boiler drums, intermittent feeding followed by condensate flushing, automatic chemical injection in ratio to flow, automatic pH control, and automatic control by conductivity.

These versatile pumps offer positive, precision control and metering of chemicals at any pressure requirements. As air-powered or motor-driven units or as components of automatic systems, Milton Roy pumps ensure utmost accuracy.

For additional information on Milton Roy Controlled Volume Pumps and Automatic Chemical Feed Systems, call the Milton Roy field representatives listed in your classified telephone directory. Or get in touch with us.

Manufacturing Engineers

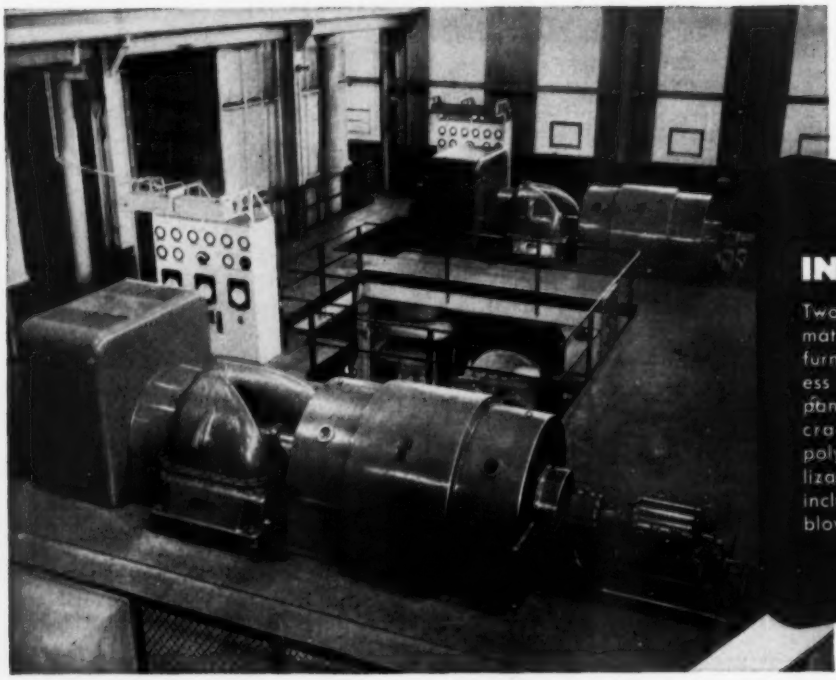
WITH THE EXCLUSIVE STEP-VALVE DESIGN

MILTON Roy COMPANY

1319 EAST MERMAID LANE, PHILADELPHIA 18, PA.

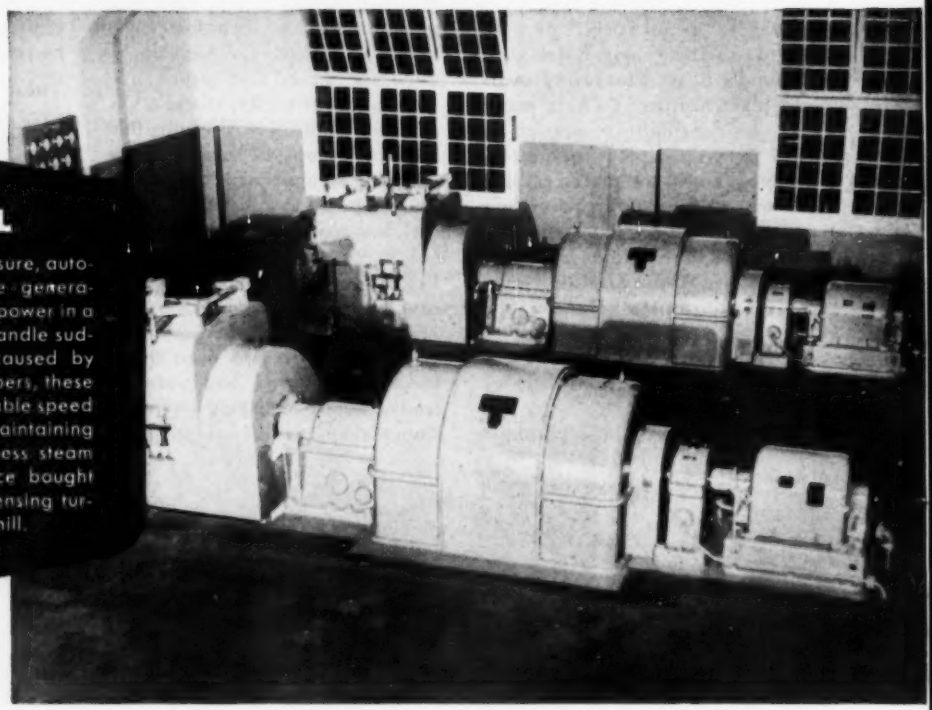
CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

Meeting Industry's



IN AN OIL REFINERY

Two Elliott 4000-kw condensing, automatic-extraction turbine-generator units furnish the power and much of the process steam required by a tremendous expansion program involving a big cat cracker and new crude, distillation, polymerization, gas recovery and stabilization units. Other Elliott equipment included in the project: turbine-driven blowers, condensers, etc.



IN A PULP MILL

Two Elliott 2000-kw back pressure, automatic-extraction type turbine-generators were installed to provide power in a modernization program. To handle sudden electrical peak loads caused by modern log barkers and chippers, these turbines have sensitive and stable speed control, at the same time maintaining pressure control for the process steam load. This company has since bought two Elliott 3500-kw noncondensing turbine-generators for another mill.

varying power needs

ELLIOTT TURBINE-GENERATORS

IN A PAPER MILL

This Elliott 2000-kw back-pressure turbine-generator is the first step in a new power generating program. It now runs in parallel with outside power, which maintains frequency and takes the electrical load swings. Future expansion calls for a duplicate generator driven by a condensing, extraction-type turbine, giving a flexible power and process steam combination in the power plant.

Producing economical power, as a by-product of process steam is the job of a properly applied turbine-generator in an industrial power plant. Elliott engineers will help you work out a type or combination of generating units which will fit the electrical and steam needs of your plant. You'll be proud of your Elliott turbine-generator's operating record.

ELLIOTT Company

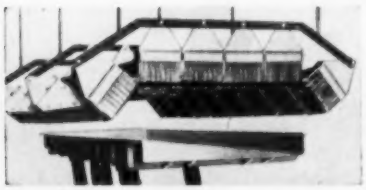
Steam Turbine Dept.
JEANNETTE, PA.

Plants at: JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
DISTRICT OFFICES IN PRINCIPAL CITIES

H2-5

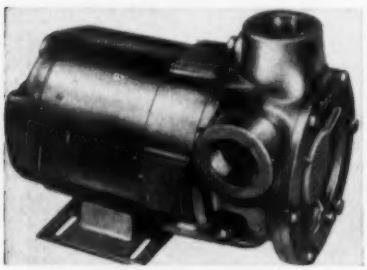
new equipment

(Continued from page 20)



Panels heat by direct radiation

C40 Infra-red radiant heating panels which heat by direct radiation, thus eliminating reflectors, are being manufactured by Syntron Co. The units throw a flat, uniform radiating pattern which is said to lower production costs and time on most baking, drying, and heating processes. They are made up of 2 to 8 flat surface elements, for operation on a-c or d-c supply. A fact sheet is available.

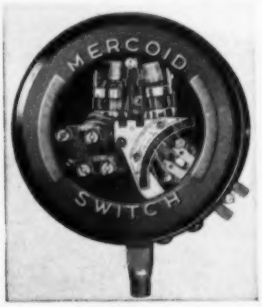


Pump includes few wearing parts

C41 Simplicity of design is featured in the Apco V-type, close-coupled, turbine type pump developed by Aurora Pump Co. The cover, inner ring, and impeller are said to be the only wearing parts. The units are reported to handle vapor entrapped in the liquid without losing prime. Capacities are from 3 to 30 gpm for heads from 0 to 250 ft. Self priming features are available.

Flexible metal conduit can be used in wet locations

C42 Sealtite type UA flexible metal conduit, manufactured by The American Brass Co., is reported to be the first of its type to gain UL approval for use in wet locations. An extruded synthetic covering over a flexible metal core protects wiring against moisture, oil, chemicals and corrosive fumes. Its flexibility is said to permit easy installation in cramped spaces and to solve problems of vibration and misalignment. Nominal electrical ID sizes of ⅛ to 1¼ in. are available.



Pressure controls incorporate two mercury switches

C43 Two independently adjustable mercury switches are actuated by a single bourdon tube in a pressure control developed by The Mercoid Corp. A calibrated dial is provided for setting the pressure at which each switch operates. Pressure ranges from 0 to 30 psi up to 300 to 2500 psi are available. Electrical capacity for each switch is 20 w at 115 or 230 v, a-c or d-c, and 0.9 amp at 24 v or less. Applications are suggested in a bulletin.

TO REQUEST ADDITIONAL FREE DATA

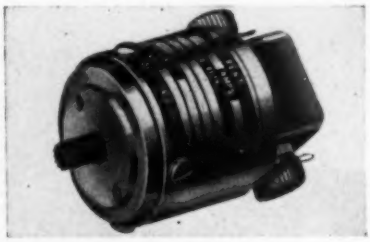
Insert "key" numbers on return post card found on page 147. Our Reader's Service Department will handle your request promptly

Illuminator provides positive gage reading

C44 For greater visibility of flat glass, water level gage readings, Yarnall-Waring Co. has designed the type M illuminator which uses a 100 w sealed-in beam, mercury vapor lamp. A greenish blue light is said to improve visibility, and the meniscus of the water column appears as a brilliant spot of light for positive location. The unit consists of the illuminator and a ballast which can be conveniently located and plugged into standard 120 v electrical systems.

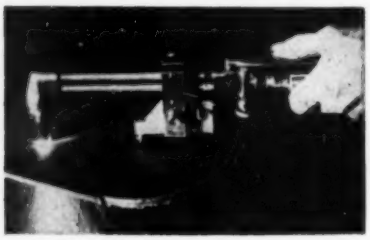
Shaft seal provides long service life

C45 Life-time performance in small pumps, hot water circulators, and many other rotary shaft applications is said to be provided by the John Crane type 19 all-purpose mechanical seal, developed by Crane Packing Co. Special beveled cones made of Teflon (DuPont trademark for tetrafluoroethylene resin) are utilized as the flexible member. It can therefore be used with water, oil, corrosives, or acids at temperatures from -100 to 450 F and pressures from vacuum to 200 psi. Sizes are available to fit shaft diameters of ¼, ⅜, ½, ⅝, and ¾ in.



Motor has electrically balanced armature

C46 True electrical balance is provided by a completely symmetrical armature winding used in a permanent magnet motor, according to Barber-Colman Co. Other advantages include improved commutation, low radio noise interference, and higher efficiency. Speeds range from 5000 to 20,000 rpm. On short cycle duty, up to 65 millihorsepower is attainable for 26 v applications. Units for 6 to 115 v d-c are listed in available literature.



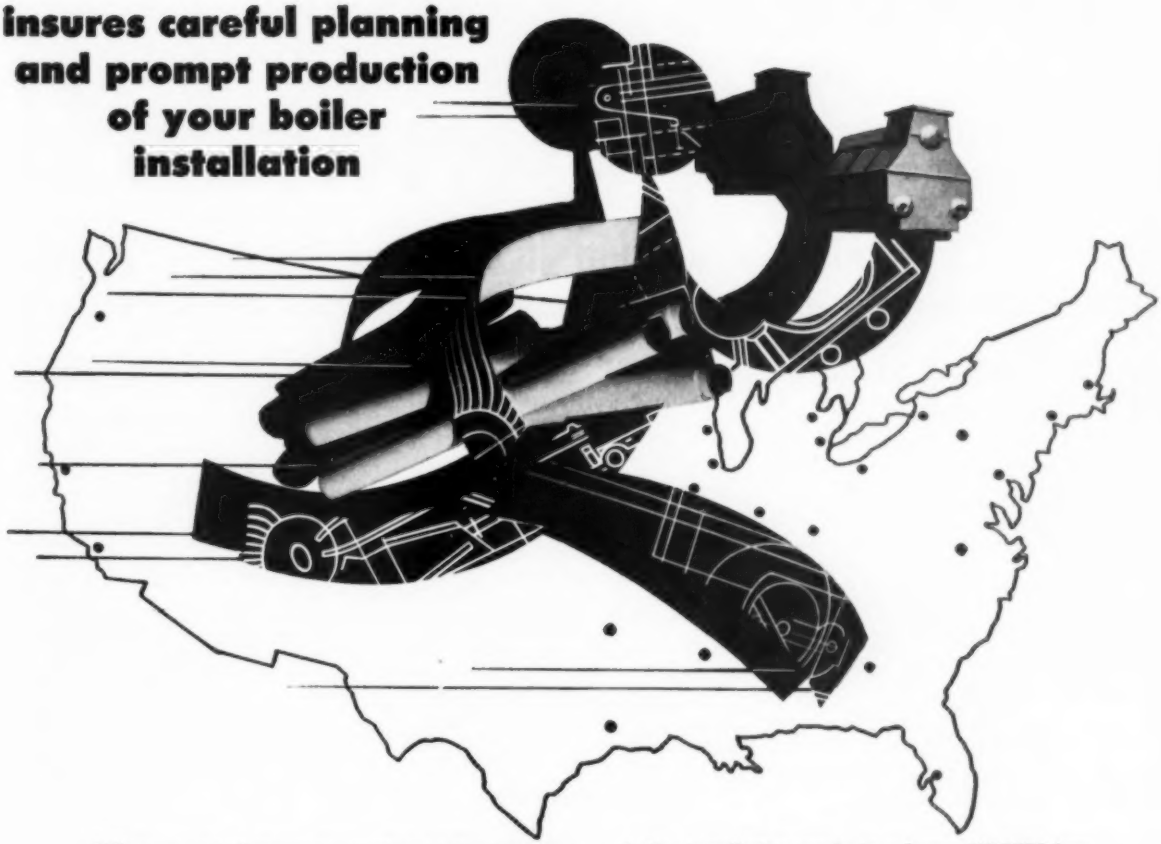
Inexpensive guides for metal cutting torches

C47 Precision type cutting guides for individual gas flame cutting torches have been developed by New Era Engineering Co. They provide a

(Continued on page 28)

WICKES SERVICE

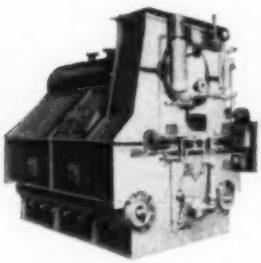
insures careful planning and prompt production of your boiler installation



When you need steam generating equipment, you want to be able to work out your requirements with experienced men who are near at hand and know boilers thoroughly. That's where WICKES can help you, because WICKES has factory-trained sales engineers in twenty-three principal cities in the United States and several industrial centers outside the country. These men are ready to help you plan your new boiler installation.

And when your plans are settled, you want your equipment installed as soon as possible. That's when WICKES engineers and production men swing into action. They rush to get your new boiler installation ready in a hurry. WICKES handles all the details—from the time the first drawings are made to the day you raise steam pressure. Then, for the life of the boiler, WICKES sales engineers and maintenance men are available day and night to keep your equipment operating at peak efficiency.

WICKES can fill your requirements for steam generators up to 250,000 lbs. per hour and 1000 psi.—all types of multiple drum boilers, adaptable to any standard method of firing. Write today for descriptive literature or consult your nearest WICKES representative.



WICKES THE WICKES BOILER COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

SALES OFFICES: Atlanta • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Detroit • Greensboro, N.C. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Pittsburgh • Portland, Ore. • Saginaw • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D.C.

RECOGNIZED QUALITY SINCE 1854

146

Revolutionary Performance!

Riley Boiler Unit gives bonus of 20,000 pounds per hour of steam to Masonite Corporation

Here's the maximum capacity guaranteed to Masonite by Riley Stoker Corporation:

50,000 lb. continuous
60,000 lb. for 15 min. peaks

And here's the Masonite report on performance: "For the past 75 days the average hourly load on the new boiler has been 70,000 pounds with peaks of one and more hours' duration of 75,000 pounds."

This same installation called for a guaranteed air heater gas temperature not in excess of 395 degrees at 50,000 pounds of steam per hour. In actual operation at 54,500 pounds of steam per hour, the air heater exit gas temperature was only 377.5 degrees!

No wonder Riley Stoker Corporation, Worcester, Massachusetts, is so well known among leading plants throughout the nation for the highly efficient performance of its boilers!

Coppus-Dennis FANMIX Burners Were Installed

To assure such revolutionary performance, Riley specified Coppus-Dennis FANMIX Burners for its boilers. The exclusive FANMIX action — on *all* Coppus burners, gas as well as combination gas-oil — is the reason for such performances.

FANMIX : Better Combustion : Better Efficiency : Higher Ratings

FANMIX burners, with their *revolving orifices*, give violent mechanical mixing and agitation of gas and air and, therefore, instantaneous and complete combustion with *minimum excess air* (5% excess air not unusual).

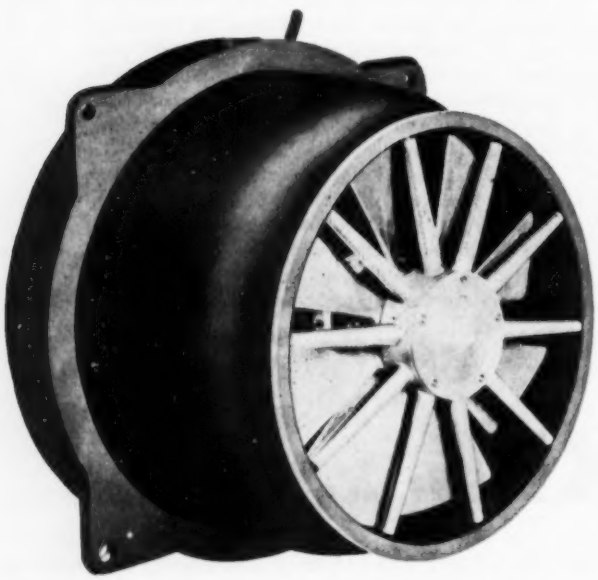
Furnace space is not required for mixing; therefore, *higher boiler ratings* are easily obtained.

FANMIX burners, with shorter flame than any other burner, cannot cause flame impingement.

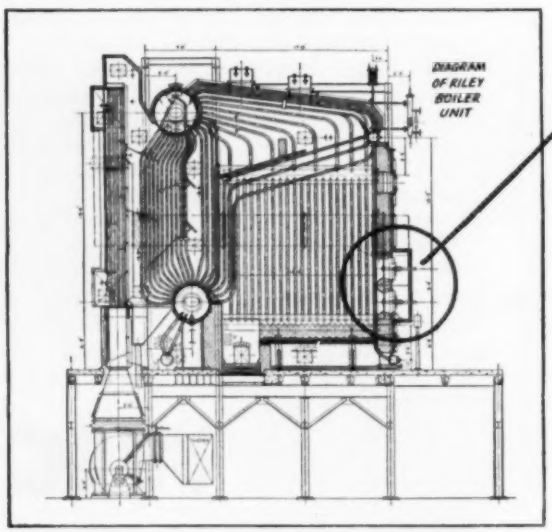
FANMIX burners, incorporating a *fan* as an integral unit, have *no draft loss* across the burner. Therefore, regardless of draft conditions, increased ratings are possible.

FANMIX action, with its quick completion of combustion, gives *lower* exit gas temperatures.

Plan now to take advantage of Coppus-Dennis FANMIX action with your present boiler. Remember — no forced draft equipment nor increase in stack nor increase in furnace volume is required for *FANMIX* operation to get increased capacity. And on *new* boilers, FANMIX lets you plan on reduced combustion space, higher ratings, less stack height or reduced induced draft capacity, and *no* forced draft equipment. Mail coupon today. Sales offices in *Thomas' Register*. Other "Blue Ribbon" Products in *Chemical Engineering Catalog, Refinery Catalog, Best's Safety Directory, and Mining Catalogs.*

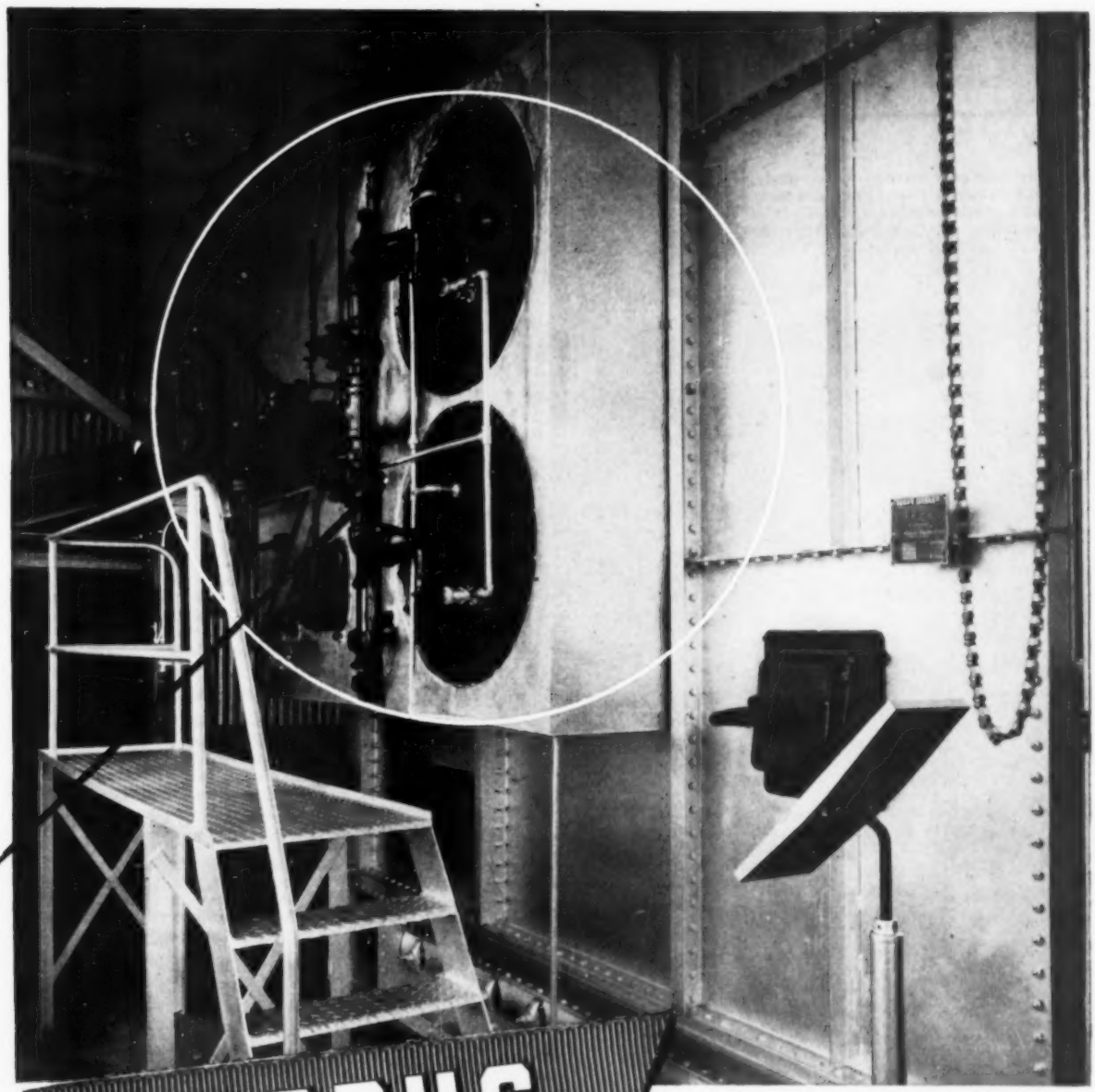


JET REACTION is utilized to rotate fan which is integral part of burner. Automatically proportioned high velocity air passes at right angles through fuel to create ideal mixture for fast, complete combustion and peak efficiency.



Well-Known Users of Riley Units with FANMIX Burners Include:

Publicker Commercial Alcohol Co.
Monsanto Chemical Co.
Gaylord Container Corp.
Commercial Solvents Corp.
Celanese Corp. of America
Gulf Power Co.
Mississippi Power Co.
Eagle-Picher Lead Co.
Humble Oil & Refining Co.
Godchaux Sugars, Inc.
Kennecott Copper Corp.
Nicholson File Co.
Bird & Son, Inc.
— and many others



COPPUS

FANMIX BURNER

GAS - COMBINATION GAS-OIL

RILEY BOILER UNIT, using FANMIX burners, is here shown as installed for the Masonite Corporation, Laurel, Mississippi. Circle in diagram at left indicates position of burners pictured above.

SEND COUPON for further information. Coppus engineers FANMIX burners to your individual requirements.

PLEASE ATTACH THIS COUPON TO YOUR COMPANY LETTERHEAD

COPPUS ENGINEERING CORPORATION
183 Park Avenue
Worcester 2, Massachusetts

Please send complete data on Coppus-Dennis FANMIX Burners. I'm particularly interested in
☐ gas ☐ combination gas-oil.

Name ..... Title .....

Company .....

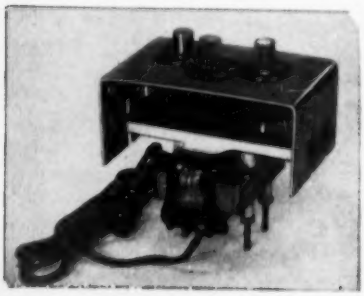
Address .....

City ..... Zone ..... State .....

new equipment

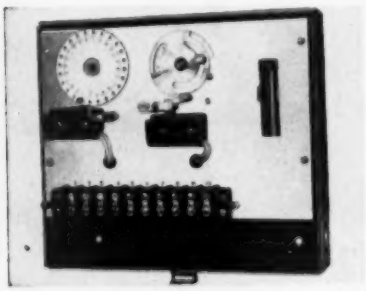
(Continued from page 24)

simple, low cost method for accurately cutting circles, straight lines and bevels without special training or skill. Styles are available to fit all makes of torches from 70 to 90 degree models.



Midget geared motors have many applications

C48 Midget electric motors with multi-purpose gear trains, known as Kasson Roto-Sho, are available in many types from General Die and Stamping Co. Gearing is offered with single or multiple shafts for any one or combination of speeds from 1 to 1150 rpm. The motor, a shaded pole induction type, operates on 110-120 v, 50 or 60 c. Suggested applications including use for valve controls, electric control drives, remote control devices, current interrupter, industrial mixers, and circulators are listed in a data sheet.



Timer with dual ranges provides flexibility

C49 Paragon Electric Co. has developed a dual-range cycle repeater unit, the CR3MB-KT2, which consists of two electrically interlocked timers. One timer regulates frequency of the other, which in turn controls duration of circuit "on" time. The unit is particularly suitable where short, variable-duration operation is required at infrequent intervals, such as chemical-feed pumping, sampling procedures, and central lubricating systems.

Thermocouple tube alloy saves nickel

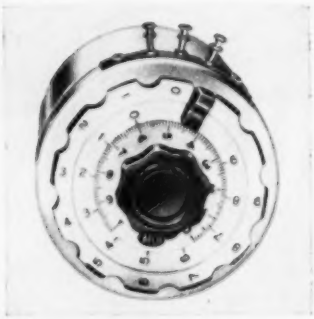
C50 To comply with a government order restricting the use of nickel, Minneapolis-Honeywell's Industrial Div. has developed a thermocouple-protecting tube of Incoloy. The company explains that physical properties of this alloy are similar to Inconel, the material previously used, but contains only half as much nickel. The alloy is rated at 1900 F.

Oil fog lubricator operates at low air pressure

C51 Extremely fine and uniform oil fog is said to be produced at low air flow by the Micro-Fog lubricator developed by C. A. Norgren Co. Listed among the important features are: constant oil level; full visibility of oil flow; accurate metering of oil delivery into the air line; and universal right to left or left to right flow without adjustment. The unit is for ¼ in. air lines. Air requirements are 0.8 cfm at 10 psi to 6 cfm at 80 psi.

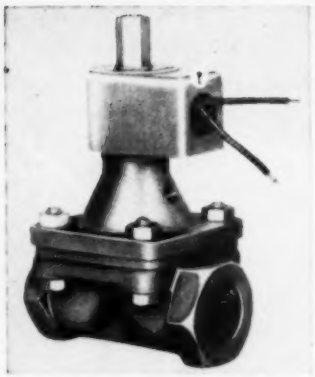
TO REQUEST ADDITIONAL FREE DATA

Insert "key" numbers on return post card found on page 147. Our Reader's Service Department will handle your request promptly



Precision potentiometers for panel mounting

C52 Two decades of fixed resistors and an interpolating slide wire to accomplish the voltage division are incorporated in Dekapot DP-211 panel mounting potentiometers developed by Brown Electro-Measurement Corp. The units, which are said to offer a high order of accuracy, provide an effective scale length equivalent to a 100 turn potentiometer. Total resistance is 10,000 ohm. Specifications are outlined in a data sheet.

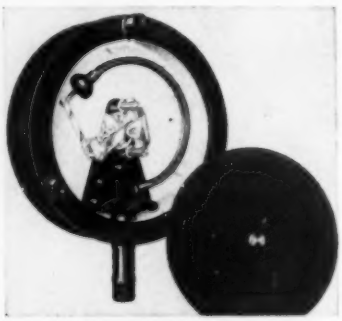


Control valve handles corrosive materials

C53 For handling corrosive liquids and gases, and for food products, particularly those containing solid particles, Automatic Switch Co. has developed a pilot-operated valve said to provide positive shut-off. It features simple construction, having only two moving operating parts: a flexible diaphragm and a solenoid core. Operation is on 115 or 230 v a-c, 50 or 60 c, and 115 v d-c. In addition to standard enclosures, watertight and explosion-proof types are described in a bulletin.

Sealer prevents staining

C54 To make the application of vinyl and other active-solvent coatings possible over previous coatings such as asphalt, coal, tar, and mastics, Prufcoat Laboratories, Inc. has developed the P-25M sealer. The product, which air dries by evaporation of solvents which have a minimum effect on such materials as oil paint and asphalt coatings, is said to prevent bleeding, staining, lifting, and wrinkling. Applications are outlined in available literature.



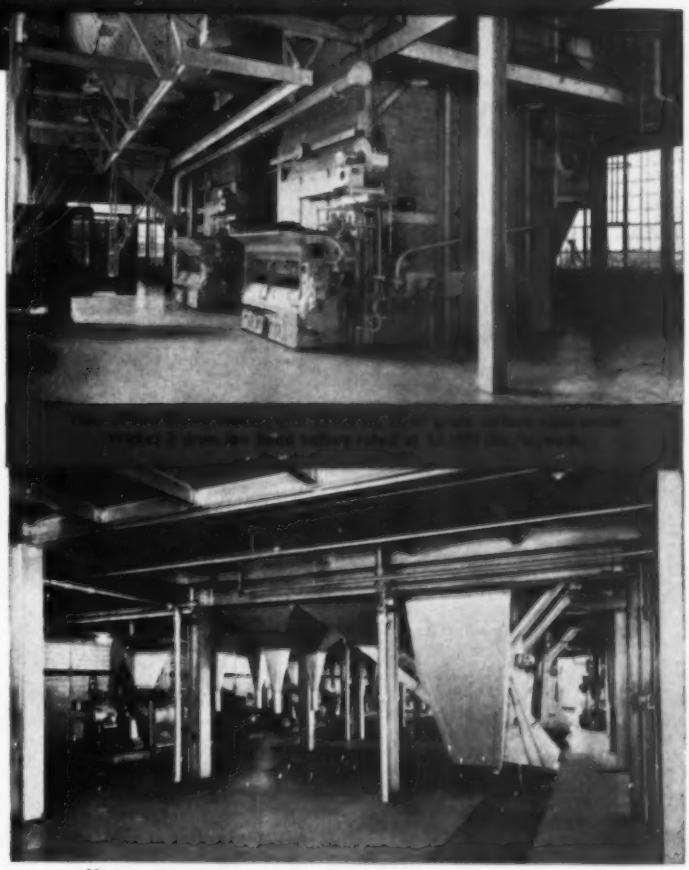
Gage design permits easy entree

C55 Quick access for inspection, recalibration, and repair is combined with absolute protection to the viewer in the Ashcroft Maxisafe Duragage, manufactured by Manning, Maxwell & Moore, Inc. An integrally cast wall separates the dial from the gage movement and tube. A double spring-mounted safety release plate covers the entire back of the case. Gages for pressures from vacuum to 100,000 psi are offered. Compound and retard ranges also are available.

— End

STOWE Stoker

HANDLES LOAD SWINGS OF *16* TO *1*
without losing ignition... without smoking and without exposing the grates



View in basement showing forced draft fans, siftings hoppers and dust tight ash removal system.

• In winter, the heating load usually results in **High Load** operation, emphasizing one group of advantages resulting from Stowe Stoker's unusual design.

And in the summer time — the absence of a heating load underscores Stowe Stoker's unique ability to operate efficiently at **Low Loads,** very important to plants handling ***both*** a heating; ***and*** a power or service requirement.

The Stowe Stoker installation pictured at the right handles load swings from

40 lbs. of Coal/sq. ft. of Grate/Hour Maximum Condition

to

2.5 lbs. of Coal/sq. ft. of Grate/Hour Minimum Condition

under automatic control — without loss of ignition — without smoking — without exposing the grates — and without any other firing problems.

Our Catalog 501 describes the unusual, "only one of its kind" design that enables Stowe Stokers to handle peak loads without "balling up" the fire, and minimum loads without loss of ignition. Write for a copy!

What Stowe Stokers are doing for others— They can also do for you!

STOWE Stokers

Manufactured by THE JOHNSTON & JENNINGS CO. • 6917 Bessemer Avenue • Cleveland 27, Ohio
.... *Division of* PETTIBONE MULLIKEN CORP...

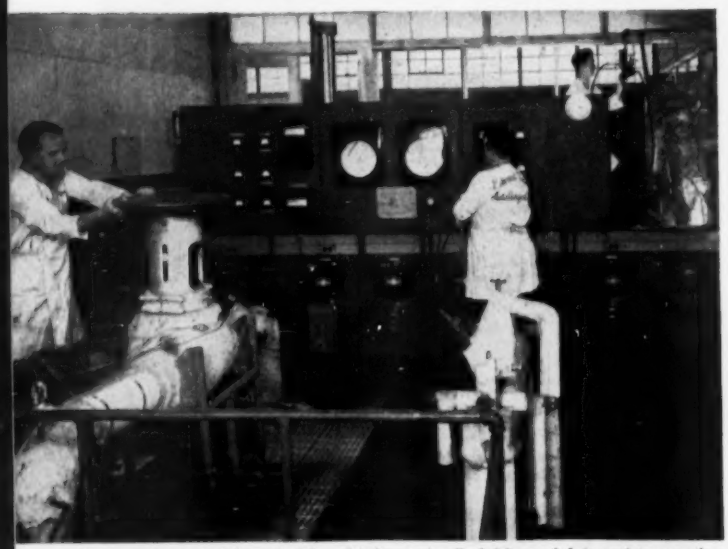
valve values
PHOTO NEWS

Ordeal by SUPERHEATED STEAM *Up to 1300F 5000 psi. for Edward Valves*

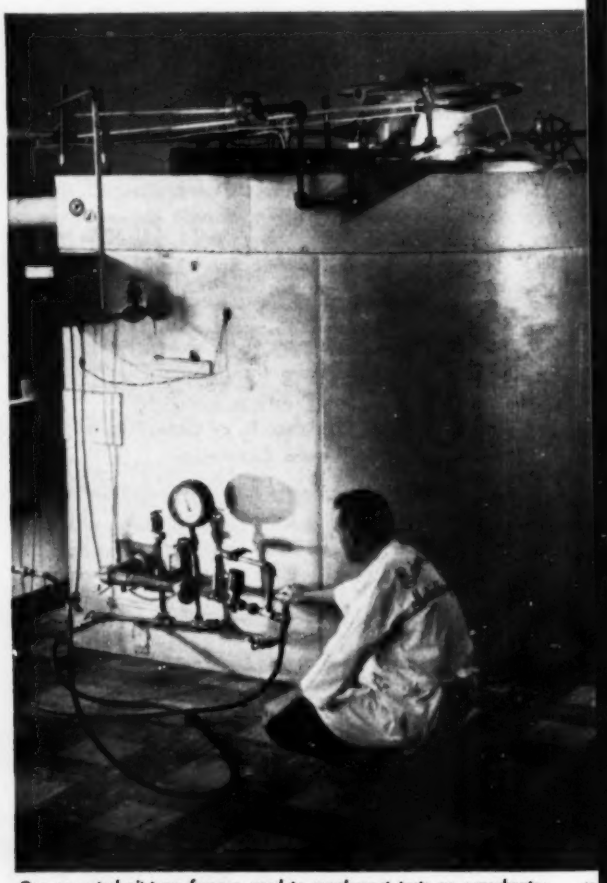
New superheater testing units, developed by Edward engineers and exclusive with Edward, permit a manufacturer for the first time to test valves under conditions much more severe than those they will encounter in today's actual service. These revolutionary new units permit circulating commercial quantities of superheated steam at temperatures up to 1300 F, pressures to 5000 psi. for unlimited periods of time in laboratory tests. Valves are thus subjected to the action of flowing superheated steam with temperatures and pressures far greater than they will meet in actual operation. Possible design weaknesses or operating difficulties are greatly exaggerated and thus readily corrected.

Development of this outstanding new research tool demonstrates Edward's constant search to improve its products—to more than meet the continual challenge posed by constantly increasing temperatures and pressures. For these reasons, Edward maintains the largest laboratories in the world devoted exclusively to research on steel valves. You can continue to expect the best from Edward.

Edward Univalves in test on superheater loop. Flow through center valve is alternated between superheated steam in main loop and high pressure water in and out of tee connection.



Two superheater test loops in Edward Laboratories. Technician at left is testing operation of 6 in., 2500 lb globe valve rated for 1033F, 2500 psi. which is under a thousand hour test at 3500 psi. and 1100 F with flow of 5000 lbs of steam per hour.



Gas operated pit-type furnace used to supplement tests on superheater loops. With this equipment, valve bodies are tested at temperatures up to 1500 F, pressure up to 5000 psi.

Edward Valves, Inc.

Another Product

Write for 16 page bulletin giving complete information on tests with revolutionary new superheater loop equipment.

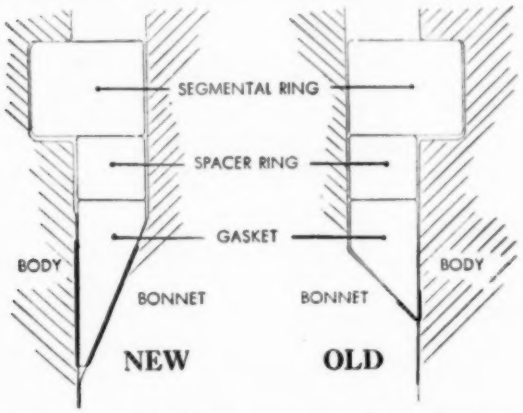
NEW IMPROVED *PRESSURE-SEAL*® DESIGN BY EDWARD

Edward, first to use pressure-sealed construction on non-return valves, has been experimenting for 8 years in an effort to improve on the original PRESSURE-SEAL design.

Final fruit of this research is the new design shown in the diagrams below. Biggest innovation in the new construction is a change in the bonnet-gasket angle from 45 degrees to 25 degrees. Other changes include a recess in the body bore above the gasket area, and a new coating applied to the gasket material.

New design advantages include:

1. THREE TIMES AS MUCH SEALING AREA. The sealing area between body and gasket is now three times greater than with the old construction. This eliminates the possibility of small leaks through minute imperfections sometimes possible with the conventional pressure-sealed construction.



2. TWICE AS MUCH SEALING PRESSURE. The new angular relationship of the bonnet and gasket gives a sealing force twice as great against the gasket for the same line load.
3. SEAL-COATING. A special coating one-thousandth of an inch in thickness is applied to the gasket. When pressure is applied to the gasket, this malleable coating is forced into tool marks and minute imperfections to give a perfect seal.
4. IMPROVED BODY SEALING SURFACE. Special preparation of the vital body-gasket sealing zone insures pressure tightness in this area.
5. EASY DISASSEMBLY. The diameter of the body bore has been enlarged just above the gasket area, facilitating disassembly and eliminating the necessity of pulling the gasket across a corroded area upon disassembly.
6. ELIMINATES GASKET DAMAGE. The cross section of the gasket has been blunted, eliminating a source of damage to the gasket during handling or storage.

Pressure-sealed construction has long been accepted as the most satisfactory for high temperature, high pressure service. These new improvements on the conventional design now available in Edward PRESSURE-SEAL Valves further establish this construction as the obvious choice for more demanding services.

EDWARD VALVES, Inc., *Subsidiary of*
ROCKWELL MANUFACTURING COMPANY
40 W. 144th STREET • EAST CHICAGO, INDIANA

GLOBE AND ANGLE STOP • FEED-LINE • BLOW-OFF • NON-RETURN CHECK • GATE • GAGE AND INSTRUMENT • RELIEF • STRAINERS

COPYRIGHT 1952, EDWARD VALVES, INC.

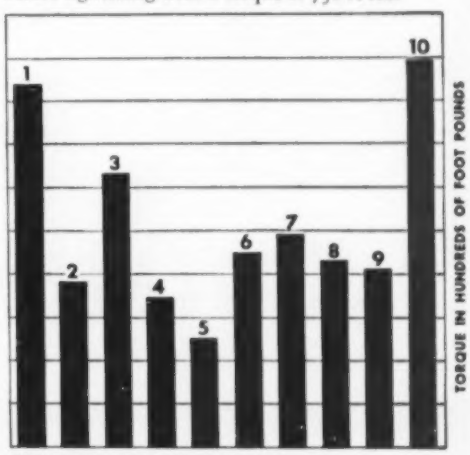
Technical Tips

High Temperature Lubricants For Valve Studs and Bushings

As temperatures increase, the problem of wear and galling between two metal surfaces also increases. Through the years a number of high temperature lubricants have been marketed to solve this problem. Most of these lubricants consist of a solid lubricant in some type of carrier which may or may not be of a lubricating nature itself.

A few years ago another new solid lubricant, molybdenum disulfide, began receiving a great amount of attention. Molybdenum disulfide has a laminar construction in which a plate of sulfur atoms is found on each side of a plate of molybdenum atoms. Molybdenum disulfide will cling tenaciously to a metal surface because of a strong metal to sulfur bond. It will slip easily against other molybdenum disulfide molecules because of the weakness of the sulfur to sulfur bond.

The chart shows the torque necessary to loosen a number of 1¼"x7" stud-nut assemblies after 5000 hours at 1000 F in a test conducted in the Edward laboratories. The stud-nut assemblies were lubricated thoroughly with various lubricants before tightening with a torque of 750 ft-lbs.



TORQUE TO LOOSEN STUD-NUT ASSEMBLY

1. No Lubricant
2. Graphite Powder
3. Colloidal Lead
4. Colloidal Copper
5. Molybdenum Disulfide
6. Aluminum Powder
7. Lime-Calcium Base Grease
8. Silicone Grease
9. Colloidal Zinc
10. Colloidal Graphite

These test results show molybdenum disulfide to be a superior stud-nut lubricant. This same superiority is also true for bushing applications. It reduces the coefficient of friction to the lowest values ever obtained on a test in the Edward laboratories and substantially increases operating life.

Edward does not manufacture molybdenum disulfide lubricants. Names of suppliers will, however, be furnished on request.

Edward

Introducing...

A NEW LINE OF AIR CIRCUIT BREAKERS

THREE NEW BREAKERS have been added to the line of General Electric Type AK breakers. This means that the AK line can be secured in interrupting ratings from 15,000 to 100,000 amperes.

SELECTIVE OPERATION up to full interrupting rating is now provided by triple-characteristic tripping devices which open the breaker to isolate a fault.

STORED-ENERGY CLOSING MECHANISM in new breakers gives safer, positive closing even against fault conditions. Closing is accomplished by energy stored in a sturdy closing spring even if control power is lost.

MULTIPLE CONTACTS give faster arc extinction, longer contact life and reduced maintenance.

INTERCHANGEABLE PARTS between breakers greatly reduce parts stocking problems. The main physical difference between breakers is the number of contact fingers which increases with rating.

COMPLETE NEW LINE OF DRAWOUT EQUIPMENT having whatever circuit pattern required, can be manufactured for shorter shipments by using standard circuit breaker compartments.

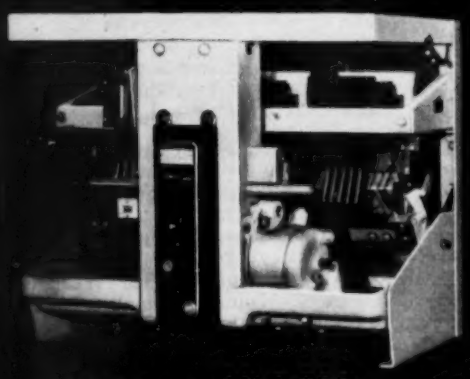
READILY ACCESSIBLE CURRENT TRANSFORMERS can be changed without disturbing bus connections.

INTEGRAL RACKING MECHANISM on removable unit cuts maintenance expenses.

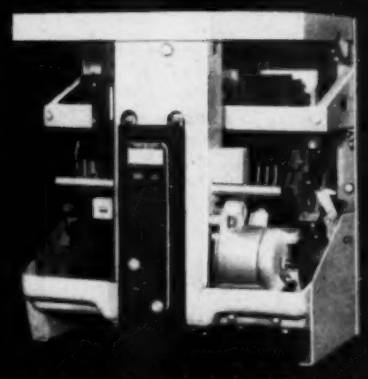
For full information, ask your local G-E sales representative for Bulletins GEA-5915 and GEA-5916 or write to General Electric Company, Schenectady 5, N. Y. 873-1

GENERAL ELECTRIC

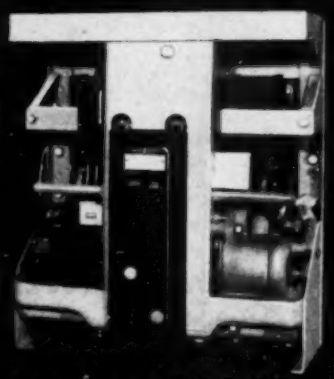
600 volts A-C 250 volts D-C



New Type **AK-1-100**
Rated: 4000 amps
100,000 amps interrupting



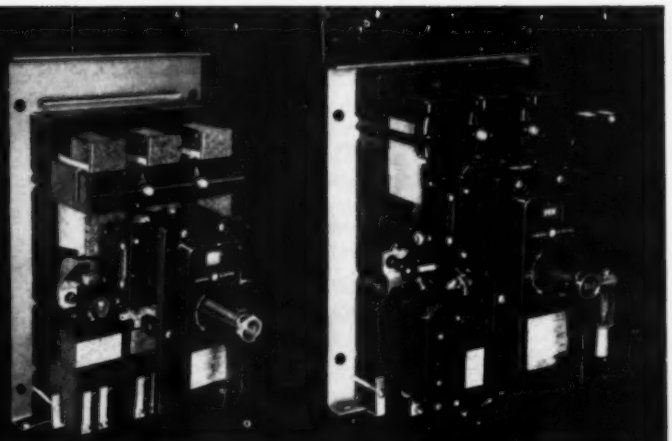
New Type **AK-1-75**
Rated: 3000 amps
75,000 amps interrupting



New Type **AK-1-50**
Rated: 1600 amps
50,000 amps interrupting

1878 75 1953
YEARS OF ELECTRICAL PROGRESS

NOW, FOR THE FIRST TIME 30-cycle momentary ratings equal to full interrupting ratings permit selective operation under all conditions.



AK-1-25 and AK-1-15 Breakers, introduced in 1948, complete the line with ratings of 600 and 225 amps, interrupting ratings of 25,000 and 15,000 amps.

New line of drawout enclosures, designed for AK breakers. Now, for the first time, a line of breakers specifically designed for drawout equipments.

COMPACT, FULL-FLOW FILTRATION FOR INDUSTRIAL FLUIDS

Fewer Cartridge Changes Necessary with MICRO-KLEAN filters

You don't need a complicated, bulky filter to keep contaminants out of your chemicals, water, lube or fuel oils. Cuno MICRO-KLEAN's compact construction gives you full-flow filtration in space which would limit ordinary filters to by-pass service.

The high porosity and low pressure drop operation of MICRO-KLEAN filters permit this full-flow service on gravity, low pressure, or suction lines—with no loss in operating efficiency.

Cartridge replacement costs are generally cut in half when MICRO-KLEANS are used. MICRO-KLEAN's graduated density-in-depth provides much greater capacity for dirt accumulation within the micronic cartridge, giving twice the useful life of an ordinary filter element.

Cuno's exclusive method of felting fibres produces a cartridge of great structural strength, free from channeling or distortion and entirely unaffected by moisture or acids. And changing cartridges can be accomplished in a few seconds—only one nut has to be removed.

Send for Cuno's free filtration analysis form, have one of your engineers fill it out, and mail it to us. We'll let you know exactly what you need for your filtration requirements—without obligation. And take advantage of Cuno's unique "money-back" offer. If MICRO-KLEAN doesn't outperform any filter cartridge you have previously used, we'll send you *double* your money back. Send the coupon today for free MICRO-KLEAN bulletin. M.3.5

Cuno Engineering Corporation
Dept. 145C South Vine Street, Meriden, Conn.

I'm interested in your "money-back" offer. Please send me your filtration analysis form—and more information on MICRO-KLEAN for

..... (fluid)

Name.....

Company.....

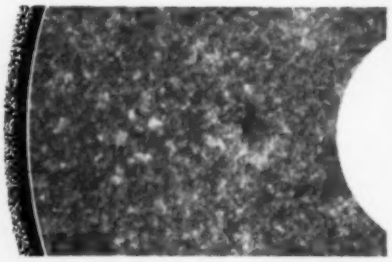
Address.....

City.....Zone....State.....

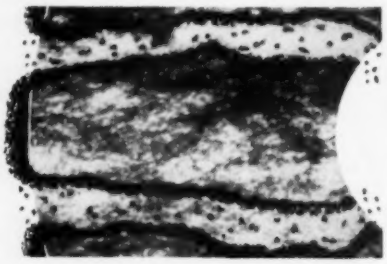
GRADUATED DENSITY

makes MICRO-KLEAN the most effective filter on the market!

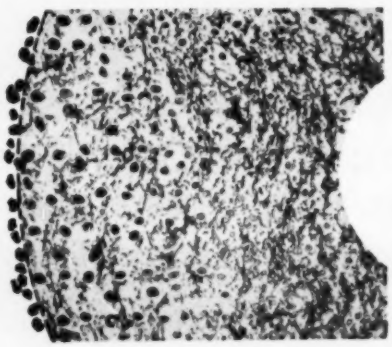
How MICRO-KLEAN compares with other cartridge filters



Compare MICRO-KLEAN with FILTERS WITH THE SAME DENSITY THROUGHOUT. The filter media density is the same on the pressure and discharge surfaces of the element; therefore, dirt accumulation is largely on the outside surface, choking the cartridge ("plastering") and reducing the effective filter life.



Compare MICRO-KLEAN with FILTERS WITH HAPHAZARD DISTRIBUTION OF FILTER MEDIA. Uneven haphazard media density permits fluid to find channels through the filter, and pass solids larger than the minimum filter spacing.



Now Look at the advantages offered by MICRO-KLEAN. See how the fibre density increases toward the discharge side of the MICRO-KLEAN filter cartridge? In effect, every Cuno MICRO-KLEAN cartridge is an infinite multiplicity of screens, ranging from relatively coarse on the outside down to 10 microns in the center. Because of MICRO-KLEAN's graduated density in depth, particles are entrapped within the entire depth of the filter element, giving the cartridge a much longer effective life. Standard cartridge size is 9¾" long by 2¾" O. D., in densities of 10, 25 and 50 microns.

MICRO-KLEAN gives you

- greater dirt holding capacity
- absolute protection against rupturing or channeling of the cartridge
- longer effective cartridge life

REMEMBER . . . IF YOU CAN PUMP IT, CUNO CAN FILTER IT

M.3.C

CUNO

ENGINEERED FILTRATION

Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)

Adjust-O-Feeder
Model X 52

- **LOW COST**
- **COMPACT**
  Built-in standard motor — no separate gearbox or couplings.
  Built-in oil-enclosed gear reducer.
- **MICRO-STROKE ADJUSTMENT**
  Scale easily read — crank and connecting rod operate in horizontal plane.
- **LONG LIFE AND EASY MAINTENANCE**
  One-piece Meehanite iron frame for positive alignment of all moving parts.
  Double check valves on suction and discharge easily removable.

This new, compact chemical feed pump, by %Proportioneers, Inc.%, is inexpensive and provides accurate boiler water treatment for plants where a low capacity, medium pressure pump will meet requirements. The standard Model X 52 has a capacity range from 1 to 10 GPH and will discharge against pressures up to 650 psig. For lower feeds, the unit is available with a range of from 0.5 to 5 GPH. Complete and self-contained, Model X 52 weighs less than 100 lbs. and is ready to operate as soon as piping and motor are connected.

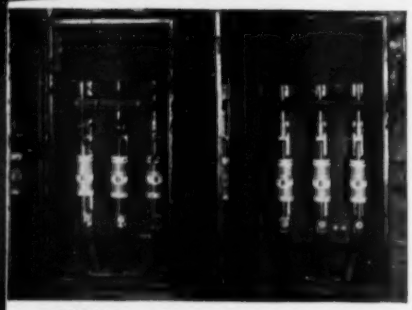
Ask for Bulletin 1105

%PROPORTIONEERS, INC.%

Write to %PROPORTIONEERS, INC.%, 357 Harris Ave., Providence 1, R. I.

Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.

for FUSE ECONOMY . . . use ECONOMY FUSES



YOU SAVE 3 WAYS!

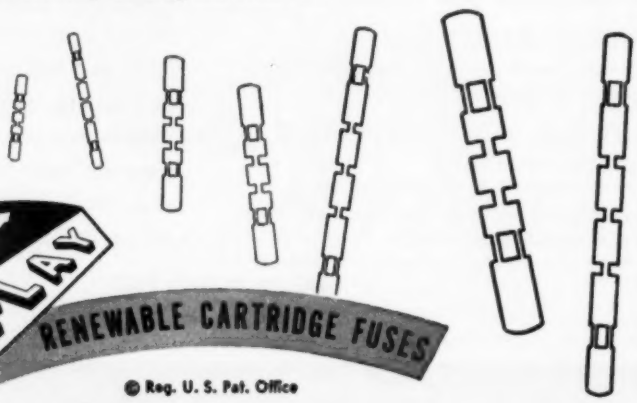
FIRST—with "ECONOMY DE-LAY" Renewable Fuses you save money every time you have a current "blow". Simply remove the blown link and replace it at the cost of only a few cents with a new, "ECONOMY DE-LAY" Renewal Link in the same cartridge.

SECOND—you save because of the short time required to make this replacement—and time is money.

THIRD—you save by reducing "down time" on machines—because an inexpensive carton of Economy Fuse Renewal Links kept on hand 24 hours a day, answers fuse renewal requirements *immediately*.

Your Electrical Wholesaler has "ECONOMY DE-LAY" Renewable Fuses and Renewal Links in stock.

Ask for the Economy Catalog and Price List.



ECONOMY DE-LAY RENEWABLE CARTRIDGE FUSES

© Reg. U. S. Pat. Office

ECONOMY FUSE AND MFG. CO., 2717 GREENVIEW AVE., CHICAGO 14, ILLINOIS REPRESENTATIVES IN ALL PRINCIPAL CITIES

5730

In the City of Jacksonville's

NEW POWER PLANT...

23 services get time-proved

BYERS WROUGHT IRON protection

In this new 60,000 KW Plant, built to meet rapidly increasing city requirements, materials were carefully selected to meet service conditions. In 23 varied services facing corrosive hazards, the designers selected genuine wrought iron to forestall the maintenance threat of early failure and costly replacement.

Over 185 tons of Byers Wrought Iron pipe and plate was installed in the following services: condensate storage tanks; surge tanks; raw water holding tanks; fuel oil inspection tanks; boiler water storage tanks; feed water chemical treatment tanks; all domestic hot and cold water lines in the building; interior fire protection system; steam supply piping, condensate returns and hot water circulating lines in connection with the heating and air conditioning systems; all outside fuel oil supply lines; fuel oil steam supply and condensate piping; fuel oil heating coils; all chlorine gas lines; outside small domestic cold water service lines under ground; evaporator blowdown and drain piping in discharge flume; cooling water piping above ground serving main condensers; cooling water piping for turbine oil coolers; cooling water piping for heat exchanger in hydrogen cooling system; and manhole steps for sewer structures.

The selection of genuine wrought iron for these services follows accepted design practice, and is endorsed by performance records that testify to the material's superior corrosion resistance. Write for our bulletin, WROUGHT IRON FOR PIPING SYSTEMS.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N. Y.

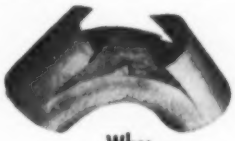
ENGINEERS
Reynolds, Smith and Hills, Jacksonville, Florida.

TANK FABRICATORS
Birmingham Tank Company, Division of Ingalls Iron Works, Birmingham, Alabama.

POWER PIPING INSTALLATION
Benjamin F. Shaw Co., Wilmington, Delaware.

GENERAL CONTRACTOR
George D. Auchter Company, Jacksonville, Florida.

MECHANICAL SUBCONTRACTOR
Henley & Beckwith, Inc., Jacksonville, Florida.



Why Genuine Wrought Iron Lasts

This notch-fracture test specimen illustrates the unique fibrous structure of genuine wrought iron—which is responsible for the high corrosion resistance of the material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

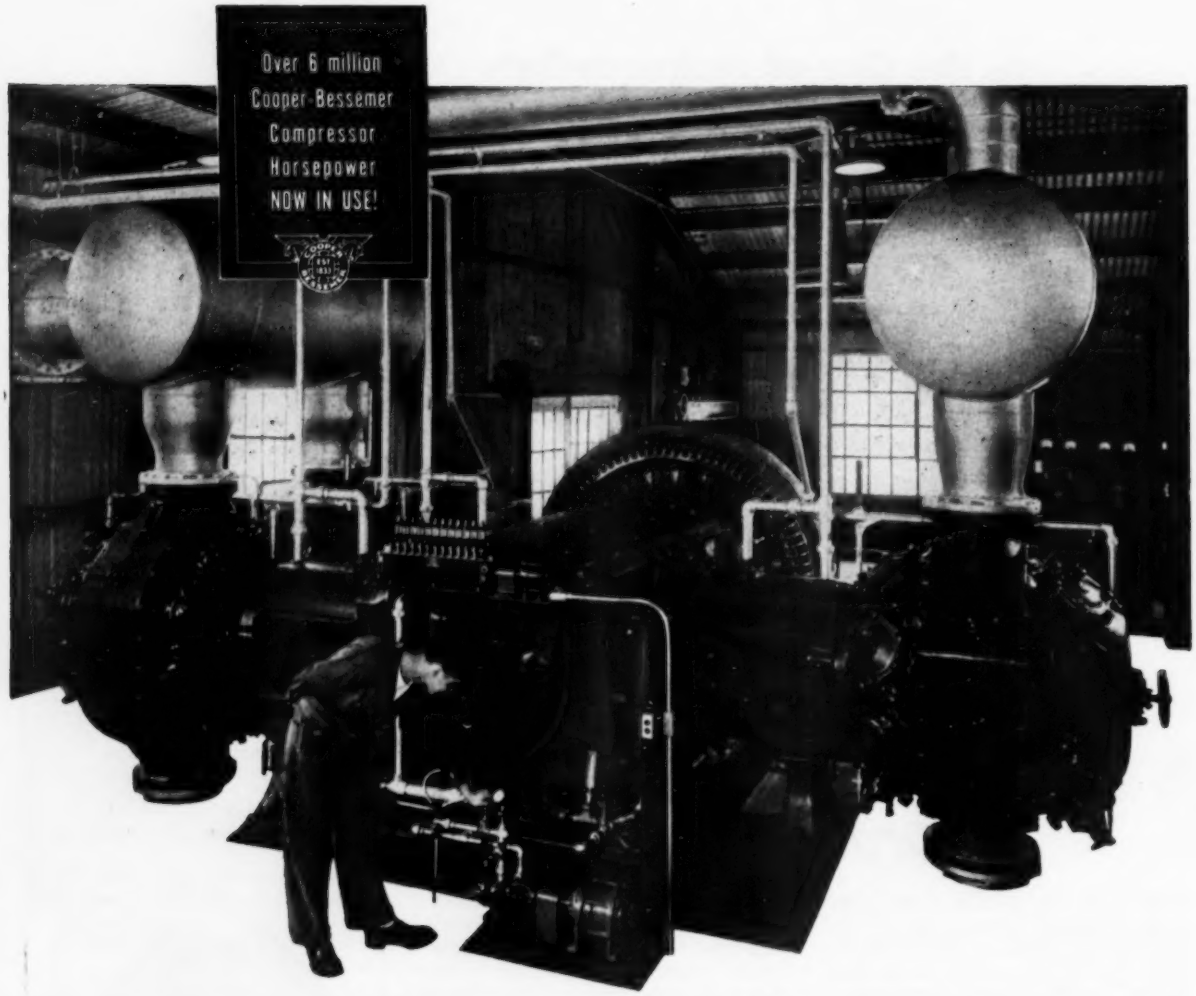
BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS



FOR PFIZER ANTIBIOTICS . . . *the "healthiest" of compressors*

AT Chas. Pfizer & Co., Inc., Vigo plant in Terre Haute, antibiotic processing is a *continuous* operation, requiring lots of air. And since air failure would be disastrous, it was essential to have the most reliable compressor obtainable. The Cooper-Bessemer unit shown above was installed over a year ago; has been in virtually constant 24-hour-a-day operation ever since.

There's all kinds of proof that you can't top a Cooper-Bessemer compressor for reliability. What's more, its modern, compact design, with vibration-free opposed action, means smoothest operation, simplified maintenance, and substantial savings in space and foundation requirements.

Send for the latest bulletin, shown here, or check with the nearest Cooper-Bessemer office on the money-saving unit just right for your needs.

SEND FOR YOUR COPY

Covers Cooper-Bessemer Type M compressors. 200 to 1000 hp. Other bulletins covering still larger size units are also yours for the asking.

The
Cooper-Bessemer
Corporation

MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York Washington, D. C. Bradford, Pa. San Francisco Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Los Angeles Chicago Caracas, Venezuela Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Gloucester, Mass. New Orleans, La.

AUTOMATIC CONTROL EQUIPMENT

HAMMEL-DAHL

Entire Process Plants, Pipelines and Pilot Units

. . . in all parts of the world, are now completely equipped with HAMMEL-DAHL AUTOMATIC CONTROL. Superior quality, experienced engineering, honest workmanship, *plus* lower maintenance and operating costs have convinced many engineers.

HAMMEL-DAHL COMPANY

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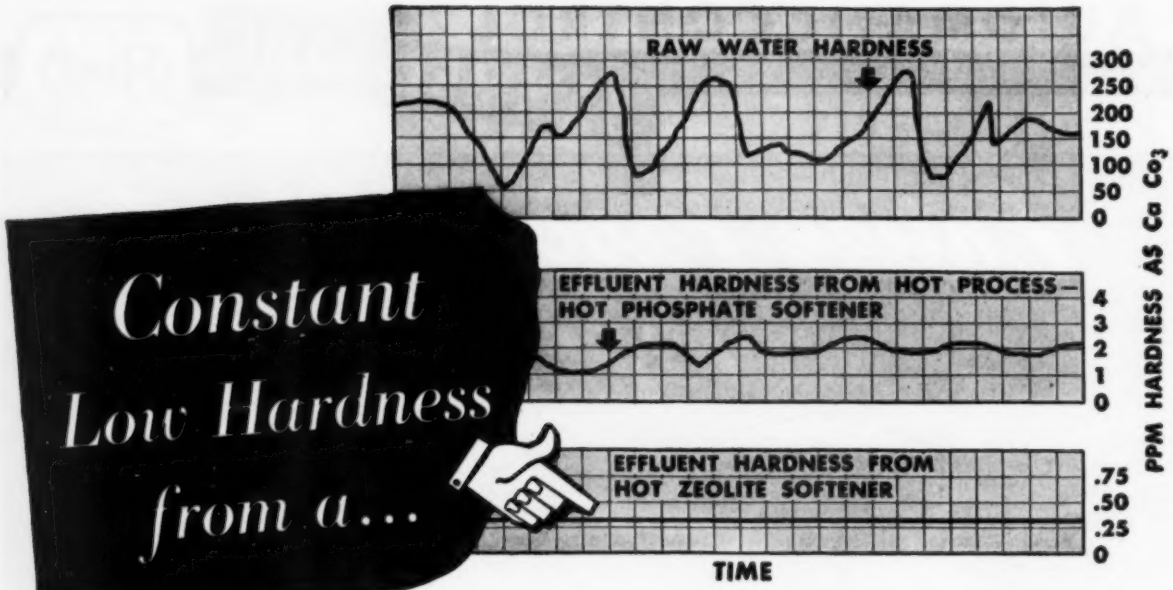
MANUFACTURED AND DISTRIBUTED BY *Canada* — The Guelph Engineering Co., Ltd., Guelph, Ontario
England — J. Blakeborough & Sons, Ltd., Brighouse, Yorks. • *France* — Prémafrance, Paris



Constant Low Hardness from a...

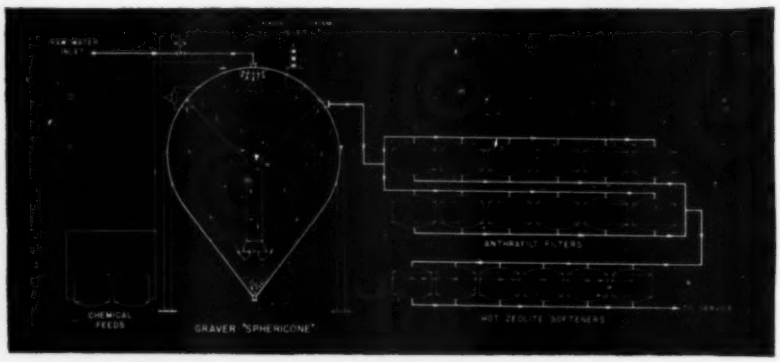
...Graver Hot Process Hot Zeolite Softener

Conventional lime-soda-phosphate hot process softeners effectively reduce raw water hardness. However, with extremely variable raw water supplies, chemical feeds must be adjusted to furnish precise quantities of chemicals in relation to raw water hardness and alkalinity in order to obtain suitable low hardness at all times.

The recent development of high-temperature resistant zeolites has provided a convenient solution to this problem. Substituting a second-stage hot-zeolite treatment, with Gravex styrene-base resin zeolite, instead of the more costly phosphate after-treatment, *constantly* low-hardness water is obtained *regardless* of sudden fluctuations in the initial hardness of the raw water . . . and at *lower cost.*

Therefore, if your raw water varies in source or hardness, be sure to investigate the Graver Hot Process — Hot Zeolite Softener. Graver engineers are available to discuss this process with you and compare its advantages over other processes at no obligation to you whatsoever.

Write for reprint of informative article on the features and benefits of hot zeolite softening.



GRAVER

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

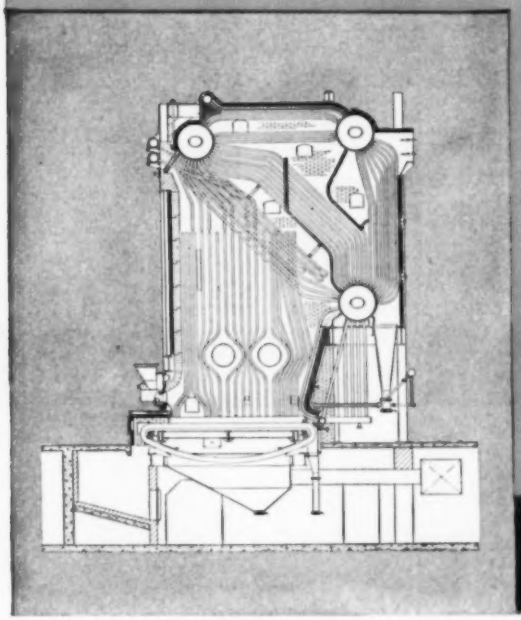
DEPT. IP-Z, 216 WEST 14th STREET, NEW YORK 11, N. Y.

In Canada: The Bird-Archer Co., Ltd.; Cobourg, Ontario
In Mexico: Proveedores Tecnicos, S.A., Puebla 259, Mexico 7, D. F.

GR-437

10,000 People are proud of their UTILITY

CITY OF FAIRMONT, MINNESOTA



BOILER DATA

2—E.C. 3-drum—80,000 lbs./hr.—750°F (TT)—399 lbs. O.P.—425 lbs. D.P.—water cooled side and rear walls—Erie City "Travagrate" Spreader Stoker with 12,000 B.t.u. Illinois coal and gas firing.

An Outstanding Record of Performance

1930—All Rates Reduced
1931—Power Rates Reduced
1932—Commercial Rates Reduced (Lights)
1933—Water Rates Reduced
1934—All Rates Reduced
1936—Power and Resident Light Rates Reduced
1940—Commercial Light and Power Rates Reduced
1943—All Electric and Steam Heat Rates Reduced
1945—All Electric Rates Reduced
1949—Increased costs forced 10% increase in all rates

The City of Fairmont, Minnesota, population 10,000, operates its own light, power, water and low pressure commercial steam heating services. The power plant, rebuilt in 1920, houses one 40,000 and one 60,000 pound boiler and two 80,000 pound per hour Erie City 3-drum steam generators added in the past five years. Its kwh generated has increased from 1.8 to 34.6 million in 1951.

The late G. E. Basom, had devoted 28 years to the careful management of this utility. Its outstanding record of rate reduction over the years is a monument to his devotion to the public trust. It is also a matter of great pride to this community that not one cent of taxes was required for financing their utility.

We are proud to have Erie City "Travagrate" Spreader fired Erie City 3-drum steam generators serving the City of Fairmont.

You can depend on Erie City for sound engineering

ERIE CITY
112 Years in Steam Generation

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

STRENGTH

for Safety and Long-Time Service

For 2000, 3000 and 6000 pounds service — Sizes 1/8" to 6"

SCREW END TYPE

For schedules 40, 80 and 160 pipe — Sizes 1/8" to 4"

SOCKET WELD TYPE

Vogt Ells, Tees, Crosses, etc., are forged from carbon steel or various alloys to meet specific operating conditions. Catalog **V-0** will aid you in their selection and proper application.

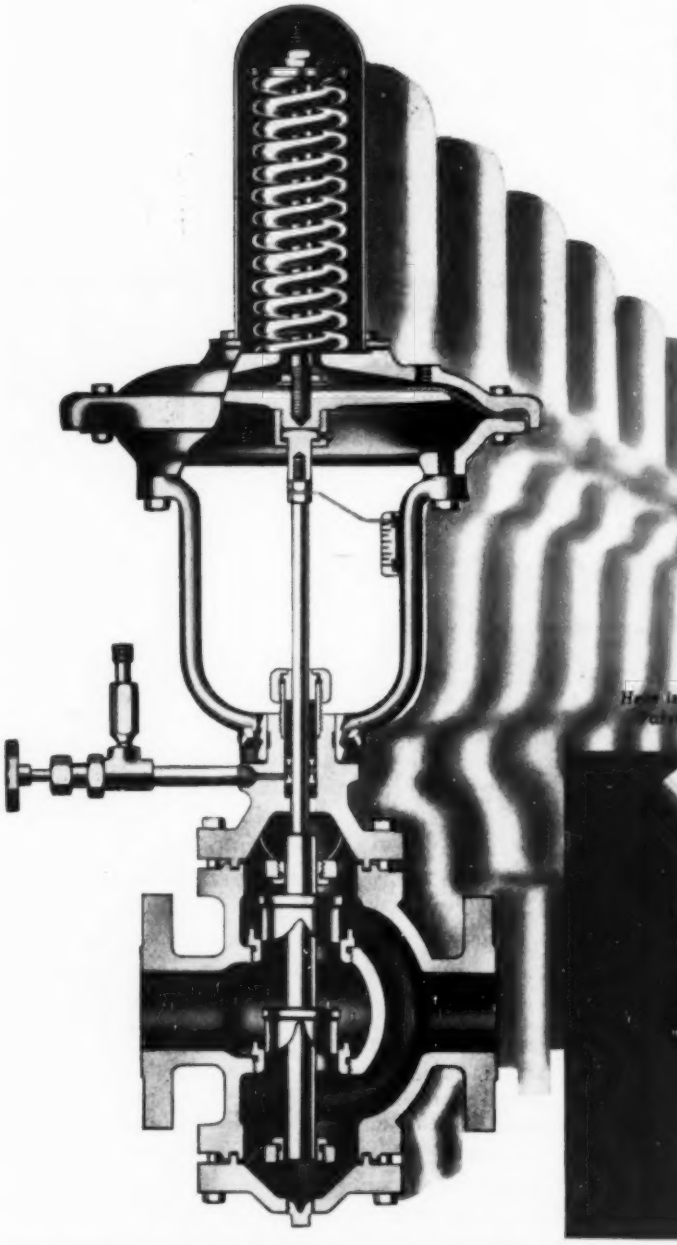
Shocks and stresses imposed by high pressures and high temperatures are taken in their stride because Vogt fittings are uniform in structure, fine grained, and free from porosity . . . the superior product of laboratory controlled materials and giant forging hammers and upsetters. These properties also give higher resistance to erosive and corrosive conditions, thereby adding to service life expectancy in steam plants, petroleum refineries, chemical plants and related industries.

HENRY VOGT MACHINE CO., INC.
Louisville 10, Kentucky
BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS

Vogt

DROP FORGED STEEL FITTINGS

LET 60,000 INSTALLATIONS GUIDE YOU TO BETTER PROPORTIONAL CONTROL



Optimum flow characteristics, coupled with free-floating, self-aligning motor action, have made "Stabilflo" the most preferred name in control valves. Ever since the development of proportional control, critical users have depended upon these wide-range V-port valves for the utmost in performance.

Because of their unique port design, Stabilflo Valves give very precise "equal percentage" flow relations throughout the range from 2 to 100% of flow. Their rangeability is 50-to-1. With these valves, you can be sure that the extraordinary sensitivity, accuracy and dependability of modern proportional controllers are translated into matching valve performance. Get the details in Bulletin 277-2. Write **The Foxboro Company, 243 Norfolk Street, Foxboro, Mass., U. S. A.**

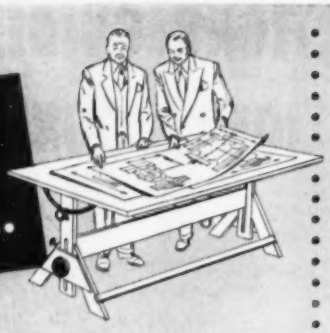
Here is the Foxboro Expanded Port that gives Stabilflo Valves their unique equal percentage characteristic.

FOXBORO
REG. U. S. PAT. OFF.

STABILFLO CONTROL VALVES

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

HOW SPENCE DESIGN...

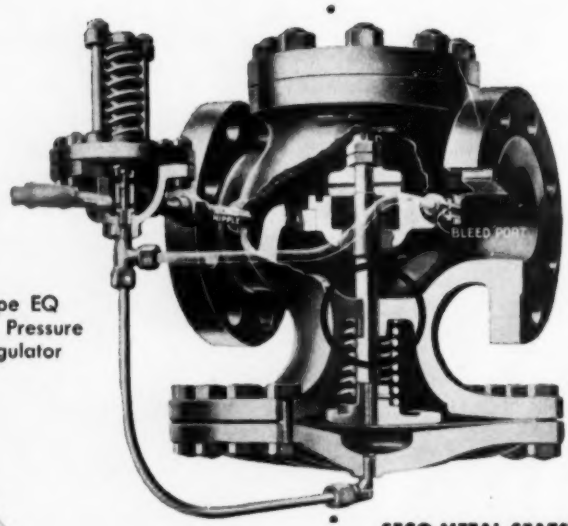


eliminates stuffing boxes

All Spence main valves and most pilots are built without stuffing boxes. This packless construction is made possible by the use of a large balanced metal diaphragm which eliminates the need for closely fitted parts. Result? More accurate regulation.

Valve stem wear is also reduced in the Spence packless design. Result? Low maintenance, years of trouble-free service.

Spence makes a wide line of automatic regulating valves: Pressure, Temperature, Differential Pressure, Back Pressure, Pump Governors and many other types. Write for bulletin 100 giving full details.



Type EQ
Back Pressure
Regulator

A few other design features:

SECO METAL SEATS AND DISCS— Durable SECO Metal resists wiredrawing. More than twenty years of experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PROTECTED SPRINGS— The internal springs in the Spence Main Valve and Pilot are out of the path of the steam or other fluid flowing through the valve. They operate at low unit stress for exceptionally long life.

METAL DIAPHRAGMS — Located in a cooled zone with a condensate seal above and below, never have to be replaced under normal conditions.

Spence

SPENCE ENGINEERING COMPANY, INC.

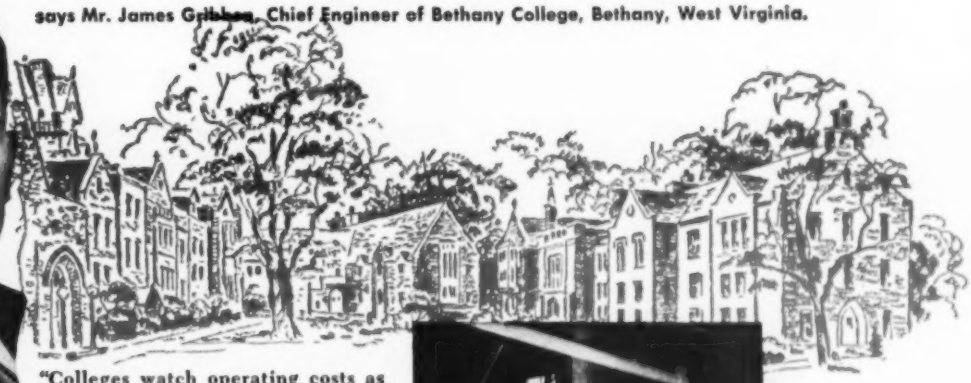
WALDEN, NEW YORK

SE 101

"We 'educated' our College Heating Plant...

with a modern coal installation we saved more than a third of our fuel bill,"

says Mr. James Gribben, Chief Engineer of Bethany College, Bethany, West Virginia.



"Colleges watch operating costs as closely as any business firm—and one big item for our college is the heating bill. That's exactly why Bethany went to the expense of putting in new coal heating equipment! Our old system supplied heat for sixteen buildings—to the tune of 2,600 tons of coal a year. Our new installation, with its automatic stoker, does the same job using only 1,650 tons. That's a fuel saving of 38.9%! Our eyes certainly have been opened to the efficiency and economy of *bituminous* coal—especially when it's burned with modern equipment."

Here's Bethany's new boiler room, showing the pipe of the automatic stoker. **THIS MODERN EQUIPMENT WILL PAY FOR ITSELF, THROUGH FUEL SAVINGS ALONE, IN LESS THAN TWO YEARS!**

Modern combustion installations can add anywhere from 10% to 40% to the energy obtained from the same amount of coal in years gone by. Great advances have been made in coal- and ash-handling equipment, too—cutting labor costs—making coal as clean and convenient to use as any fuel.

If you're planning to modernize your present installation—or thinking of building a new plant, call in a competent consulting engineer. He'll show you how a modern coal system designed to meet your specific needs can save you money and serve you better!

And don't forget—you'll always be able to get the coal you need. America's coal industry is the most efficient in the world. America's coal reserves are ample for centuries to come. Right now and for the future, too, coal users can be assured of a dependable fuel supply at reasonable prices.

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
Washington, D. C.

If you're running your own steam plant—for heat or for power—you just can't afford to ignore these facts!

COAL in most places is today's most economical fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

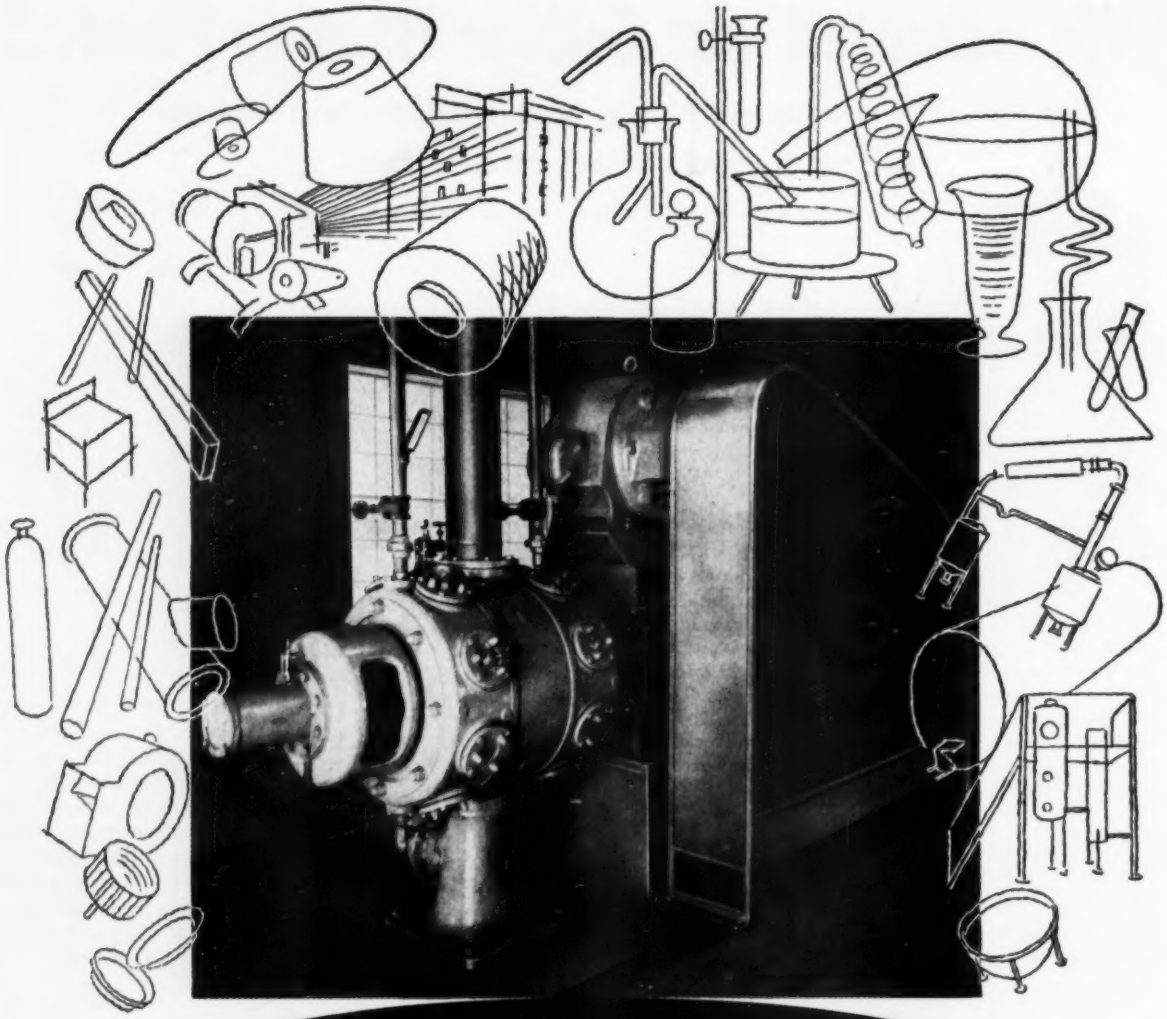
COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY — FOR LOW COST

YOU CAN COUNT ON COAL!



Protect Products

WITH CP OIL-LESS CYLINDER COMPRESSORS

If you use air for operating instruments or if you process chemicals, beer, food or other products where oil-laden air would be a detriment, you need a Chicago Pneumatic Oil-Less Cylinder Compressor.

Available in three types, CP Oil-Less Compressors have carbon piston rings — need no oil or other lubricant. The Class T-BO illustrated above has a full-floating piston with an outboard cross-head. Piston weight is not carried by the cylinder wall or the carbon rings — rings act only as a compression seal against the hardened steel cylinder liner. A distance piece between cylinder and frame, and carbon piston rod packing prevent transmission of oil into the cylinder from the frame.

For more details, write for Bulletin 728 Supplement D.

CHICAGO PNEUMATIC TOOL COMPANY
8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

What's New
IN BOILER WATER LEVEL INDICATION?

Yarway Remote Liquid Level Indicator, manometric type, with automatic temperature compensation.

IMPROVED *WIDE VISION* REMOTE LIQUID LEVEL INDICATOR

A new-type face on the Yarway Remote Liquid Level Indicator now permits side as well as head-on dial readings. This vastly improved visibility makes it possible to check boiler water levels from most any position in the control room, or wherever the Yarway Remote Indicator may be installed.

MANOMETRIC TYPE

The Yarway Indicator is a manometric type with automatic temperature compensation. Level readings are instant and accurate because the indicator is operated by the boiler water itself. The indicating mechanism is never under pressure. There are no stuffing boxes.

Over 8,000 Yarway Remote Liquid Level Indicators are successfully operating throughout industry—primarily for indicating boiler water levels, but also for many other liquid level applications, and for superheater pressure differential indication aboard ship.

For full information on Yarway Indicators, write for Yarway Bulletin WG-1823.

YARNALL-WARING COMPANY • 109 Mermaid Avenue, Philadelphia 18, Penna.

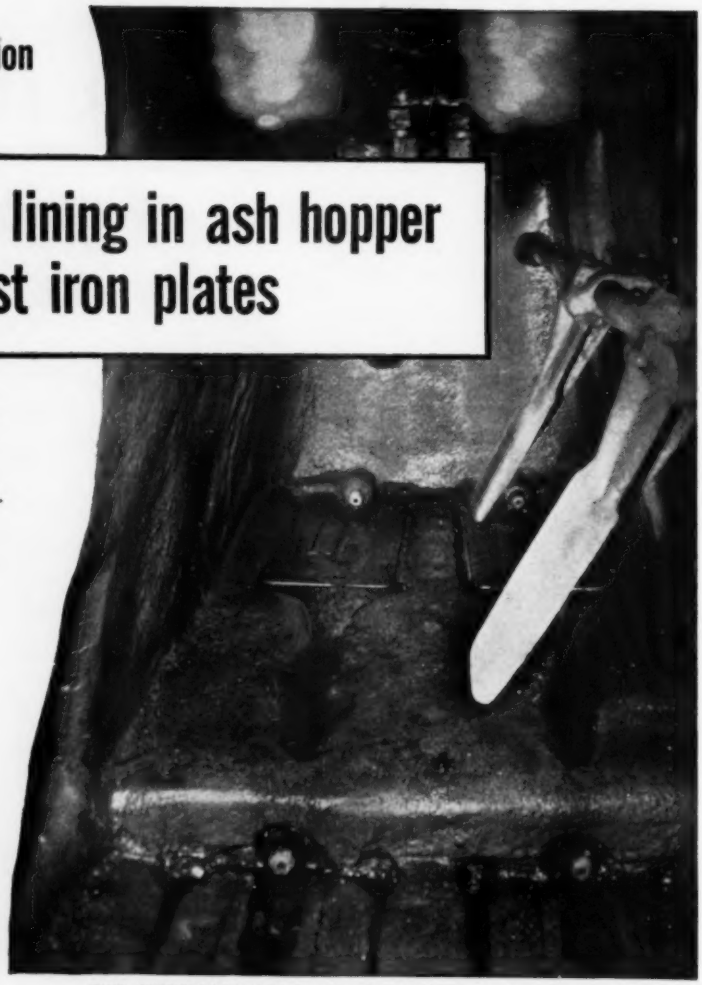
YARWAY *STEAM PLANT EQUIPMENT*

Westinghouse Electric Corporation finds that . . .

Low-cost LUMNITE* lining in ash hopper outlasts cast iron plates

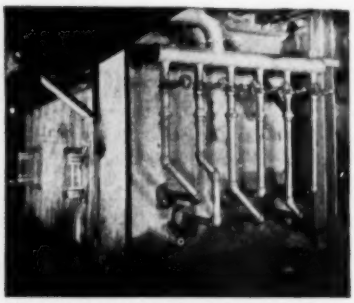
Instead of replacing cast iron plates on this ash hopper, Westinghouse engineers simply specified a 2" lining of Heat and Corrosion-Resistant Concrete made with Lumnite cement. They've found it does a job fast . . . costs *far less* than new plates . . . and lasts much longer. In fact, they're so well pleased with Lumnite they now use it to line all their ash hoppers.

Does their experience with Lumnite cement suggest profitable uses to you? It's proved to be a better way to line stacks, breechings and flues . . . make coal bunkers, ash pits . . . cast door linings, water wall studding and baffles, and make many fast repairs. Concrete made with Lumnite calcium-aluminate cement reaches service strength within 24 hours. With appropriate aggregate it withstands heat of 2600°F. or more, and it's highly resistant to abrasion, corrosion and thermal shock.



THIS GIANT ASH HOPPER at the East Pittsburgh, Pa., power plant of Westinghouse got its durable lining of Lumnite concrete in a hurry. Lining was simply shot on with a cement gun.

CAST IRON PLATES on this ash pit were a major maintenance item—until Westinghouse used Lumnite concrete linings as in top photo.



LININGS made with Lumnite proved so successful, Westinghouse engineers specified Lumnite for this all-concrete ash hopper at the Trafford, Pa., Power Plant.

FOR CONVENIENCE in making Refractory and Insulating Concrete, you may prefer to buy prepared Castables. These packaged mixtures of Lumnite and selected aggregates are tailor-made to meet your specific temperature and *insulation* requirements. Add only water. They are made by refractory manufacturers and sold through their dealers.

For complimentary booklet on the many uses of time- and-money-saving Lumnite write: Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y.

*"*LUMNITE" *is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

IP-L-64-R

ATLAS® **LUMNITE for INDUSTRIAL CONCRETES**

REFRACTORY, INSULATING, OVERNIGHT, CORROSION-RESISTANT

A UNIVERSAL ATLAS PRODUCT

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

"Clean Enough to Suit Aunt Lena"

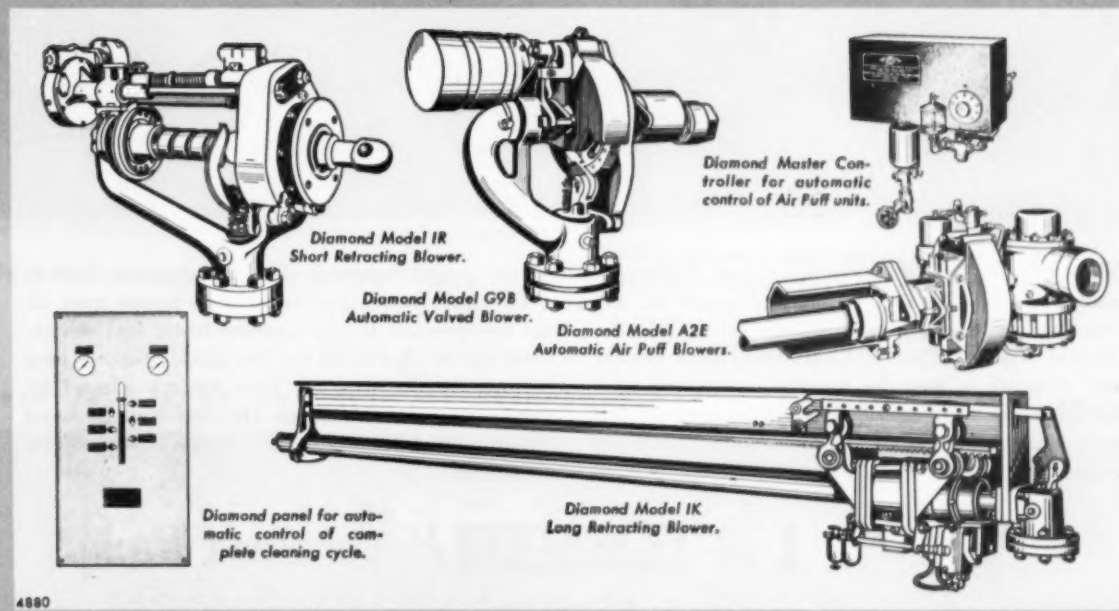
That's DIAMOND'S Boiler Cleaning Objective

According to "Kaffeeklatsch" gossip in Pittsburgh's German quarter (circa 1900), Aunt Lena scrubbed all the floors every day, washed the porch, steps and sidewalk and swept the street to the middle. Certainly she was an uncompromising and relentless enemy of dirt. Her house was so clean it excited the envy of the women, and frightened little children and husbands . . . no mean feat in the exacting colony of the "Scrubbin' Dutch".

Aunt Lena became a legend and a standard of perfection. "Clean enough to suit Aunt Lena" became the hole in one, the one-round knockout, the no-hit pitching in those dirt-annihilation circles.

Probably it wouldn't be possible to keep a boiler clean enough to "suit Aunt Lena", but Diamond Blowers can and do keep them clean enough to meet the most exacting requirements of engineers throughout the country. Diamond gives you better boiler cleaning—at lower over-all cost.

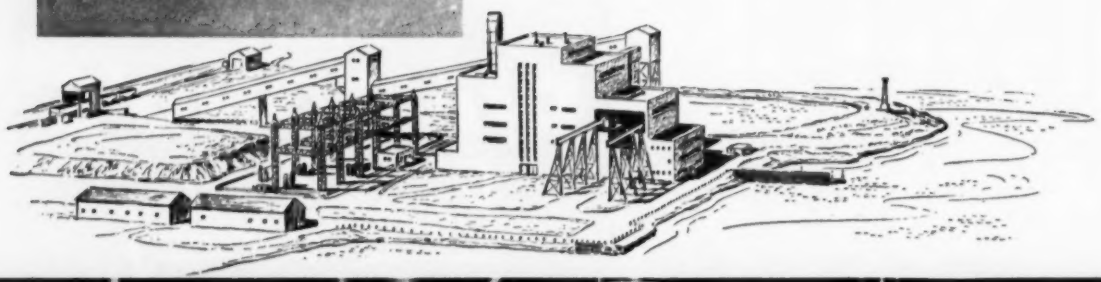
DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited — Windsor, Ontario

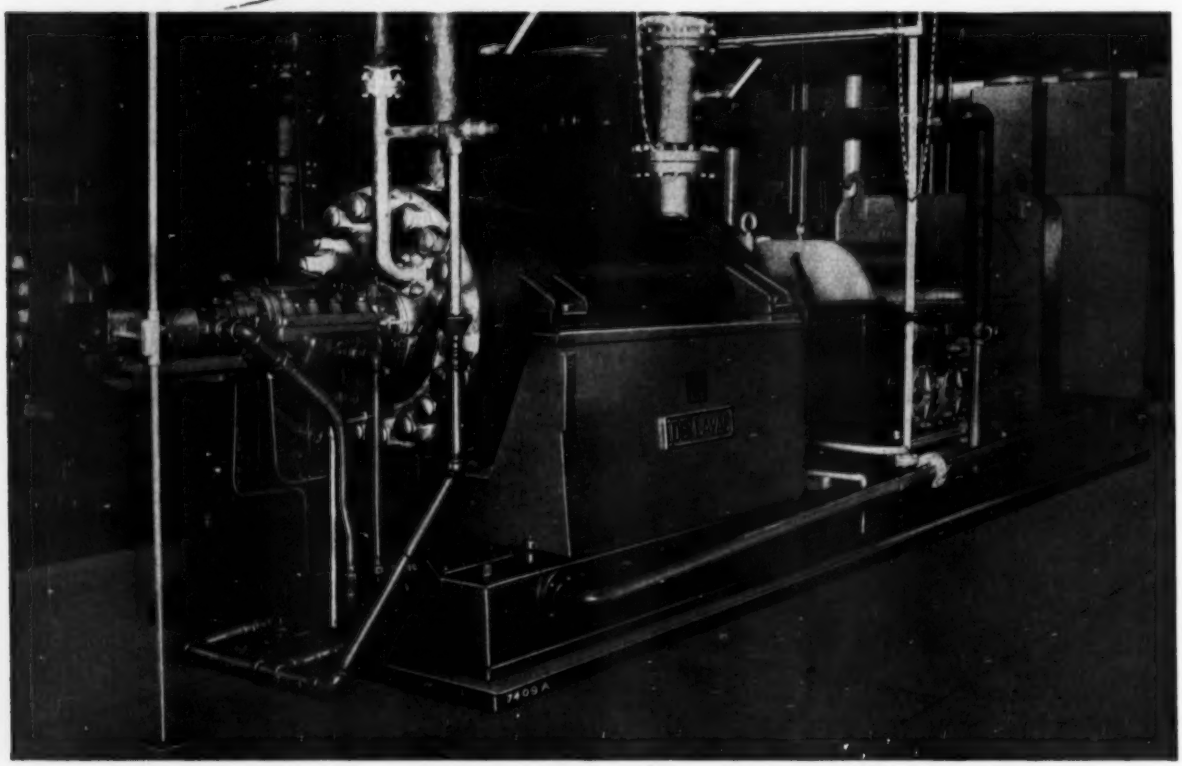

Diamond Model IR
Short Retracting Blower.
Diamond Model G9B
Automatic Valved Blower.
Diamond Master Controller for automatic control of Air Puff units.
Diamond Model A2E
Automatic Air Puff Blowers.
Diamond panel for automatic control of complete cleaning cycle.
Diamond Model IK
Long Retracting Blower.
4880

DE LAVAL

BARREL TYPE
BOILER FEED PUMPS

on the job at Danskammer Point





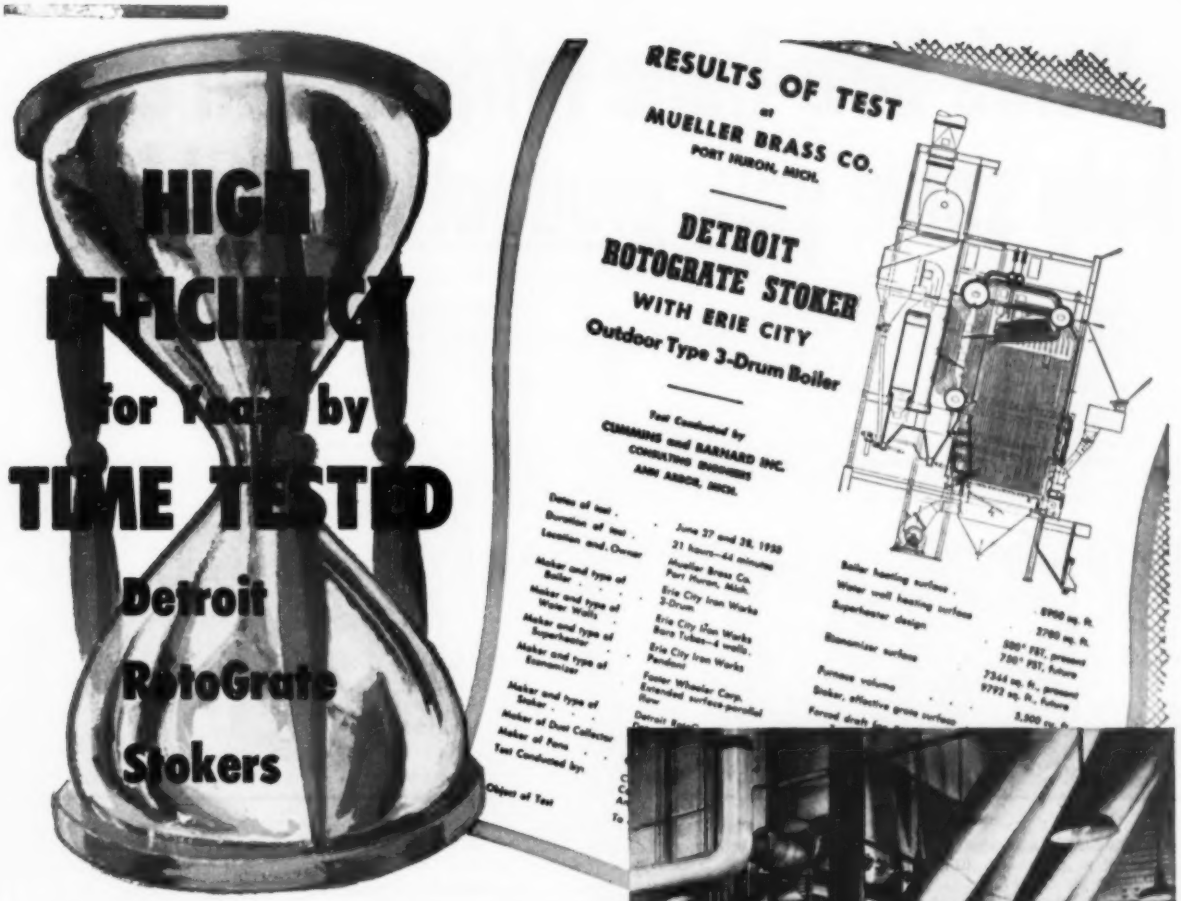
These two De Laval 11-stage barrel type boiler feed pumps are now helping to produce power for the Danskammer Point Steam Station of the Central Hudson Gas and Electric Corporation. Both pumps, one of which is used for standby service, are sized for full boiler load and will deliver 1,400 gpm of 326F water against 2,155 psig discharge pressure. Two more same size De Laval pumps have already been ordered for the second main unit of the Danskammer Station.

De Laval barrel type boiler feed pumps meet all the requirements of high pressure boiler feed service. They can be thrown on the line quickly without long preliminary warming up. They are not affected by sudden temperature changes. The distinctive De Laval design assures years of reliable service with minimum maintenance.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY
857 Nottingham Way, Trenton 2, New Jersey

DL 178



Results of tests of the Mueller Brass new steam generating unit by the consultants were most gratifying. They are typical of Detroit RotoGrate Stoker performance.

Especially important to you as a buyer is the *test of time*. Performance records of the RotoGrates in hundreds of plants—show high overall thermal efficiency, high availability and extremely low maintenance with all grades of coal.

Detroit RotoGrate Stoker applied to the 110,000 pound unit at Mueller Brass Co., Port Huron, Mich.

Write for Detroit RotoGrate Bulletin

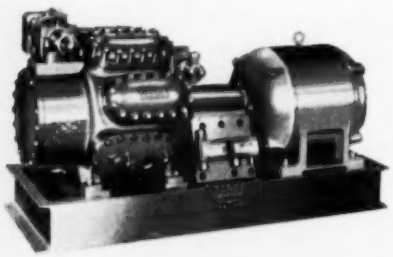
There is a Type and Size Detroit Stoker for Every Industrial Need

Detroit Stoker Company

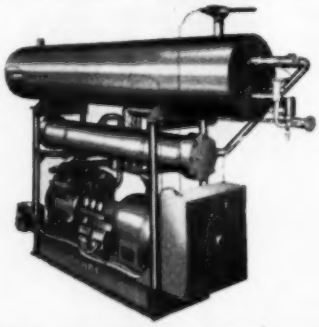
Buhl Building, Detroit 26, Mich. • Works at Monroe, Mich. • District Offices in Principal Cities

Here's how Trane refrigeration can help solve your production problems

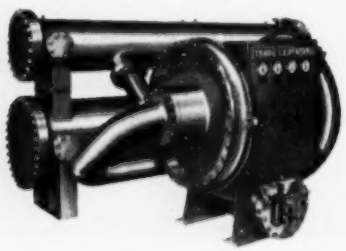
DEHUMIDIFYING and controlling moisture accurately can, as you well know, speed production, improve quality, reduce waste and spoilage. If this is your problem, talk to TRANE. TRANE Reciprocating Compressors, combined with TRANE Climate Changers, control humidity in textile mills, printing plants, storage areas, precision parts finishing and assembly rooms . . . and hundreds of other places. These compressors incorporate the most advanced engineering features. Capacities from 3 to 50 tons.



WATER CHILLING for industrial processes such as electroplating, metal quenching, die cooling, rubber mixing and multi-color printing is now available from a *single* packaged unit . . . the TRANE Cold-Generator. This unit is completely assembled, charged and tested before shipment. Only simple wiring and plumbing connections required. Ten sizes for loads from 10 to 100 tons.



PROCESS AIR CONDITIONING applications in many large plants require water chilling capacities greater than 50 tons. If this is true in your plant, read this: The TRANE CenTraVac, a hermetic centrifugal unit, provides 45 to 200 tons of refrigeration. Self-contained, easily installed, completely automatic . . . the CenTraVac runs without special attention. No shaft seals or gear boxes. Only two main bearings in entire machine.



COMFORT AIR CONDITIONING is needed at many places in modern plants . . . offices, drafting rooms, tabulating machine rooms and other heat-gain areas. It increases employee efficiency, pays dividends in cleanliness too. It's smart to air condition—with TRANE. TRANE Self-Contained units arrive ready to run. Only simple electrical and plumbing connections are required. Six sizes from 3 to 20 tons capacity.

What's your special problem? Whether yours is a simple cooling problem or a complex one . . . whether it's large or small . . . the complete line of TRANE matched air conditioning products contains the right size and type equipment to fit the job. For detailed information, call your nearest TRANE sales engineer, or write to TRANE, La Crosse, Wis.

To solve any comfort or process air conditioning problem . . . talk to **TRANE**

The Trane Company, La Crosse, Wis. • East. Mfg. Div., Scranton, Penn.
Trane Co. of Canada, Ltd., Toronto • 80 U.S. and 14 Canadian Offices

MANUFACTURING ENGINEERS OF HEATING, VENTILATING AND AIR CONDITIONING EQUIPMENT

if

—your compressor plant must be independent or isolated

—economy is an important factor

—existing power facilities are overloaded

—steam or electricity is not readily available

Ingersoll-Rand XVO Diesel-Powered Units are the answer to your compressor problems

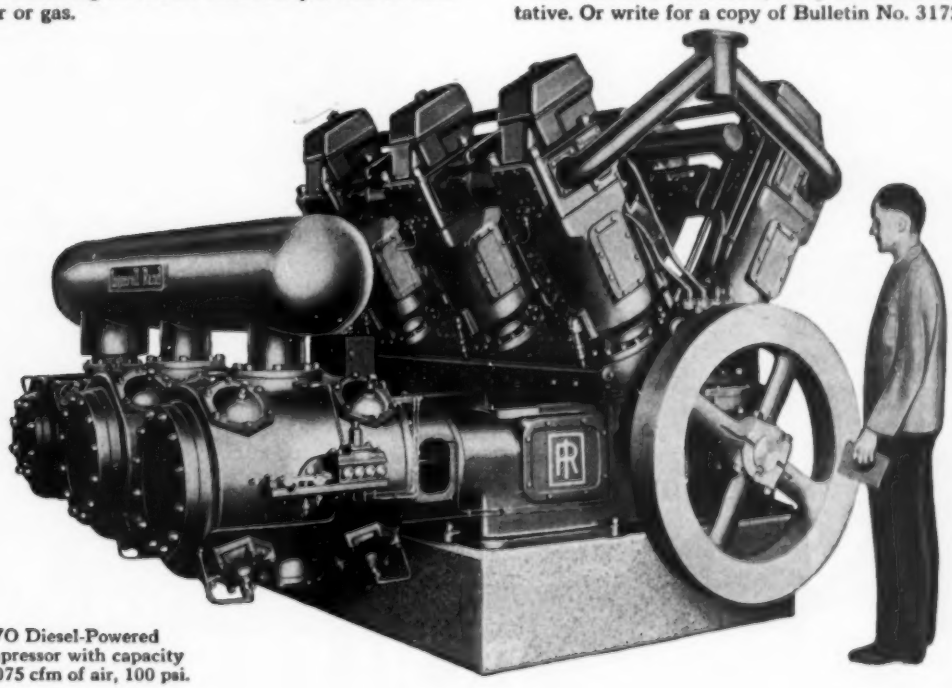
Here's an all-in-one diesel engine and compressor unit that has no equal for space-saving, cost-saving economy—plus proved *dependability* of the entire compressor plant.

The heavy-duty, double-acting compressor cylinders and four-cycle, V-angle power cylinders are mounted on a single, compact frame. The pistons in both the power and compressor cylinders are connected to the same crankshaft. Power loss between engine and compressor is practically eliminated—resulting in lowest fuel cost per cfm of compressed air or gas.

The XVO permits important savings in installation cost, too, as it is normally shipped fully assembled and ready to mount on a small inexpensive foundation.

Ingersoll-Rand XVO diesel-powered compressors are available in 335, 700, 1075, and 1450 cfm sizes (100 psi air), with 2, 4, 6 and 8 power cylinders respectively. Compressor cylinders for any pressure or vacuum can be furnished.

For further information, see your nearest I-R representative. Or write for a copy of Bulletin No. 3172-A.



6XVO Diesel-Powered Compressor with capacity of 1075 cfm of air, 100 psi.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 726-6

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO-BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

NOW! A BRAND-NEW BULLETIN SHOWING the COST-CUTTING FEATURES of the FAMOUS

EconoTHERM Boiler

Read about a *modern* boiler — *streamlined* to present-day engineering standards — and built by an old, experienced firm with new ideas!

See all the advantages of the EconoTherm's *exclusive* off-center firing fully described!

Check over each up-to-the-minute fact on EconoTherm's top-quality features.

INDUCED MECHANICAL DRAFT • ROTARY COMBUSTION • FULLY AUTOMATIC OPERATION • MODERN WELDED BOILER SHELL • STAINLESS STEEL AIR RING • GAS, HEAVY OIL, LIGHT OIL FIRING • COMPLETELY "PACKAGED" DESIGN

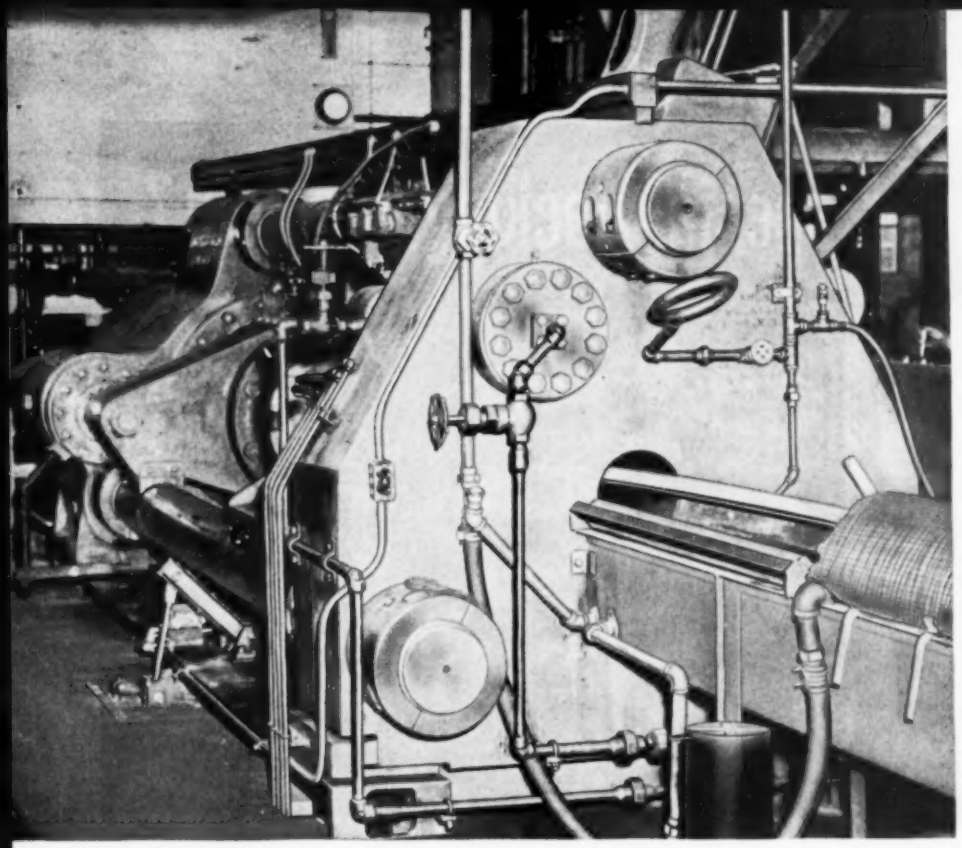
Then see *how* these features combine to give you *everything you're looking for in a long-lived, efficient steam generator!*

GET YOUR COPY NOW!
Write for EconoTherm
Bulletin EC-52 B

CHECK FIRST with Dutton

Dutton BOILERS

KALAMAZOO, MICHIGAN • DIVISION HAPMAN-DUTTON COMPANY
BOILER BUILDERS SINCE 1880
FOUR TYPES — SIZES FROM 5 to 250 h.p.



Puts squeeze on hydraulic press maintenance...

• Shown above is the 1250-ton hydraulic press used by the Light Metals Corporation of Grand Rapids, Michigan, for extruding variously shaped sections of aluminum. When this press was installed recently, officials gave the important hydraulic oil job to STANOIL Industrial Oil. They based that decision on their own experience with this outstanding oil.

That experience covered over four years' use of STANOIL in the hydraulic system of a 315-ton extrusion press. STANOIL has served continuously in this press without being changed or removed for oil maintenance. The hydraulic oil system has never been cleaned and has remained entirely free from deposits and varnish. Hydraulic operation has been efficient at all times.

The experience of the Light Metals Corporation is your assurance of STANOIL's ability to reduce hydraulic system maintenance to a minimum in your plant. This versatile oil will provide clean, dependable lubrication for such a variety of equipment as air compressors, reduction gears, and electric motors. The Standard Oil lubrication specialists will help you make the most effective use of STANOIL. Phone him at your local Standard Oil (Indiana) office. Or write, Standard Oil Company, 910 S. Michigan Ave., Chicago 80, Ill.

STANOIL
TRADE MARK
Industrial Oil

What's YOUR problem?

D. R. Clay, of Standard Oil's Grand Rapids, Michigan, office, is the lubrication specialist who has helped Light Metals Corporation keep maintenance of hydraulic units at a minimum through use of STANOIL Industrial Oil.

He is one of many Standard Oil specialists located throughout the Midwest. These men have the practical experience and special training to handle lubrication problems on any type of operation.

Take advantage of the service offered by the lubrication specialist nearest your plant. You can contact him easily by phoning your local Standard Oil Company (Indiana) office. With his help, find how many different oils in your plant can be replaced by STANOIL Industrial Oil on such applications as:

Air compressors . . . no sticking or clogging of valves, less oil consumption in splash or circulating systems.

Speed reducers . . . less wear of gears and bearings during frequent cold starts or prolonged high-temperature operation.

Steam turbines . . . freedom from emulsions and sludge, fewer oil changes necessary.

Ring-oiled bearings . . . rings function immediately on starting, less bearing wear.

Circulating and bath systems . . . one oil for a wide variety of jobs.

STANDARD OIL COMPANY **STANDARD** *(Indiana)*

What is your special packing problem?

- [ ] Pressure
- [ ] Maintenance
- [x] Acids
- [x] Alkalis
- [ ] Complicated inventory
- [ ] Temperature
- [ ] Petroleum products
- [ ] Food products

If it's handling acids and alkalis or other chemicals . . . use R/M Teflon Packings*

Raybestos-Manhattan manufactures a complete line of Teflon packings and gaskets. Teflon is not affected by chemicals within the temperature range of –80°F. to 500°F. No known industrial acids or caustics will attack Teflon; it has no known solvent.

R/M Teflon Packings and Gaskets are available in a variety of combinations for glass, glass-lined and stainless steel piping, and for pumps, valves and practically all kinds of fluid-handling equipment.

If you cut your own gaskets or fabricate parts like pump impellers and valve discs, order R/M Teflon in sheets, rods or tubes to specification. R/M Teflon Packings represent only one of the many different types of packing made by Raybestos-Manhattan. Whatever your packing problem, see your authorized R/M distributor. He has the answer for you.

R/M K-68—Compressed asbestos sheet.

R/M No. 303—Braided asbestos packing with Monel wire.

R/M versi-pak*—For general use.

R/M No. 920—Flexible metallic packing.

R/M Vee-Flex*—automatic packing rings.

Du Pont trade-mark for its tetrafluoroethylene resin.

R/M

PACKINGS

RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn., Manheim, Pa., Passaic, N.J., No. Charleston, S.C., Crawfordsville, Ind., Canadian Raybestos Co. Ltd., Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Teflon Products • Asbestos Textiles • Industrial Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Sintered Metal Products • Bowling Balls

PUTTING IT ON THE LINE...

in Industry after Industry!

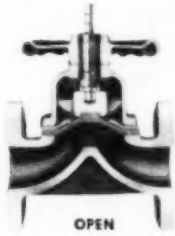
The Grinnell-Saunders Diaphragm Valve . . . . . .

Here's why . . . Piping in today's complex industrial plants is an exacting science involving the handling of highly corrosive fluids, gases, compressed air, beverages, foods and suspended solids . . . in lines where corrosion, abrasion, contamination, clogging, leakage and maintenance are costly factors. Under such conditions, the amazing adaptability of the Grinnell-Saunders Diaphragm Valve explains its acceptance by industry after industry.

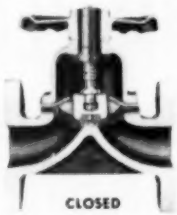
Bodies of this versatile valve are made in a variety of metals — iron, stainless steel, bronze, aluminum and others. *But of more importance* is the fact that a body of cast iron (a metal not in short supply) can be lined with glass, lead, natural rubber, neoprene and other materials which, in many instances, handle corrosive fluids *better* than metals.

Diaphragms come in natural rubber, neoprene, butyl, hycar, a special synthetic for foods, and KEL-F. This last is chemically inert to all acids and alkalies in all concentrations with the exception of molten alkali metals.

From this broad selection of materials, the problems which the Grinnell-Saunders valve can solve are extremely varied. No wonder industry after industry is putting it on the line.



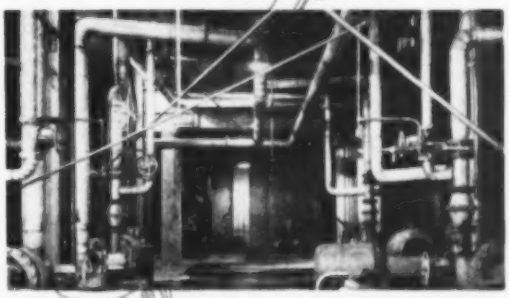
Showing rising spindle . . . valves are available with rising or stationary spindle.



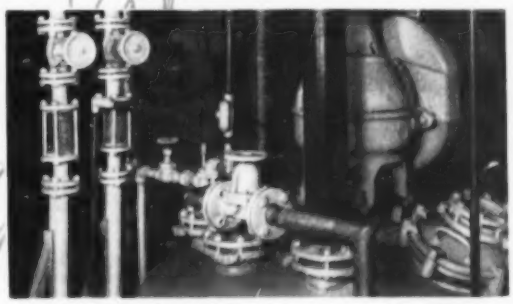
KEL-F diaphragm, using special rubber backing cushion and floating tube nut design.

CHECK THESE GRINNELL-SAUNDERS FEATURES...

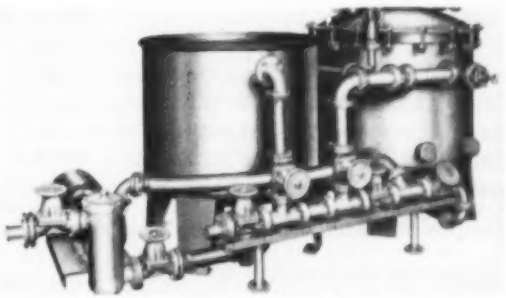
- Diaphragm absolutely isolates working parts from the fluid.
- Diaphragm lifts high for streamline flow in either direction.
- Diaphragm presses tight for positive closure.
- Body, lining and diaphragm materials to suit service.
- Simple maintenance — diaphragm easily replaced.



PULP AND PAPER MILL. Rubber-lined Grinnell-Saunders Valves on stainless steel piping handle sulphate pulp stock in a typical bleach plant.



CHEMICAL PLANTS. Glass-lined Grinnell-Saunders Diaphragm Valves, with KEL-F diaphragms, handle chlorinated organic chemicals in one plant of the chemical industry.



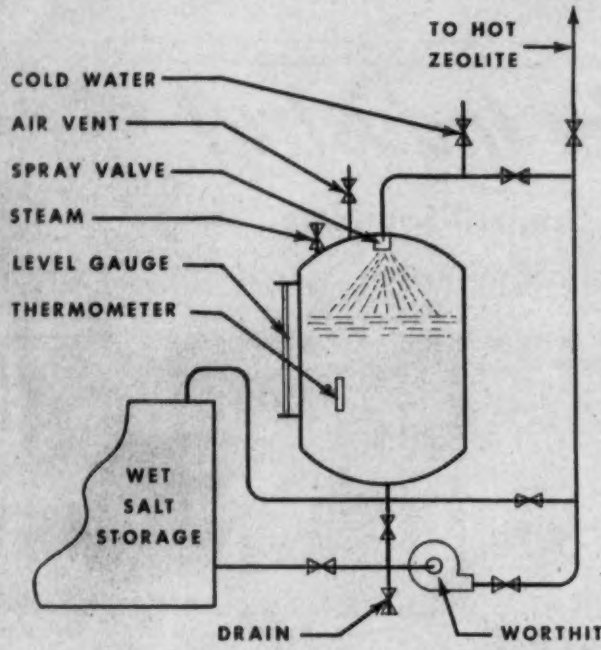
EQUIPMENT MANUFACTURERS. Grinnell-Saunders valves with rubber linings are standard on filtration equipment for solution clarification, on this manufacturer's equipment.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems



SEQUENCE OF OPERATION OF WORTHINGTON'S HOT-Z REGENERATING SYSTEM*

1. To initiate service, gradually raise zeolite to operating temperature by regulating steam supply to injection water.
2. Return excess water to wet salt storage or discharge through drain.
3. Fill heater storage with saturated brine to desired level.
4. Recirculate until operating temperature is reached.
5. Deliver measured, heated and deaerated brine to zeolite.
6. Return excess brine to wet storage for resaturation.
7. To cut zeolite out of service, inject fully heated water and gradually reduce temperature by regulating steam supply.

*patent applied for.

MAXIMUM LIFE FROM ZEOLITE

How Worthington's Hot-Z Plant protects Zeolite by maintaining uniform temperature during regeneration

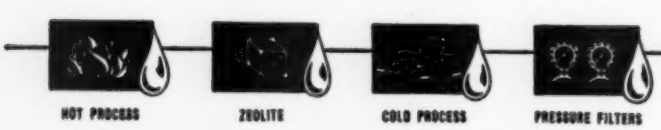
Another feature to check into when you're choosing Hot-Z treating equipment: *the regenerating system.*

For maximum life of the zeolite, two requirements should be met. 1. *A uniform temperature* should be maintained while regenerating the zeolite: that is, the regenerant solution should be held at essentially the same temperature as the water under treatment. 2. When putting a softener into or out of service, the temperature of the zeolite should be raised or lowered *gradually.*

Worthington has accomplished this dual objective with a brine deaerating heater for regenerating the hot zeolite. Its operation is explained in the diagram and accompanying caption. Deaeration is desirable to retard corrosion which might be caused by oxygen in the brine.

This heating system is just one of several exclusive features you'll find in every Worthington Hot-Z system. Remember, too, that Worthington makes all of the major types of water conditioning systems. Let us study your problem and recommend the most suitable solution. Write, stating service conditions in detail, to Worthington Corporation, Water Treating Division, Harrison, N. J.

J-2-3



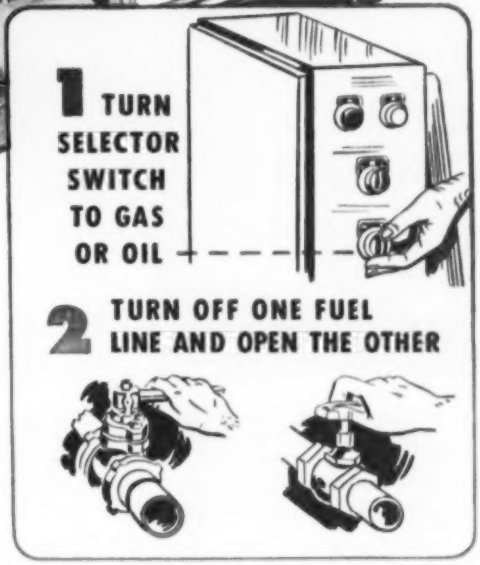
Worthington Makes More of the Equipment for ALL Types of Water Conditioning Systems

WORTHINGTON

Water Conditioning

NOW... interchange Gas and Oil firing in *10 seconds*

Modern Cleaver-Brooks Model LR Steam Boiler Equipped with Exclusive Cleaver-Brooks "10-second conversion" Combination GAS and/or OIL Burner



TWO, simple motions eliminate time-consuming change-over

Now you can use oil or gas at the flick of a switch! This exclusive new Cleaver-Brooks development permits changeover from oil to gas or vice versa in only 10 seconds.

That's because the Cleaver-Brooks Combination Gas and/or Oil Fired Boiler operates on gas *with the oil burner in place*. Simply flipping a selector switch on the control panel to either gas *or* oil sets the proper circuit in action. Turning the convenient fuel supply valves completes the entire changeover — and in 10 seconds or less!

To gas users in all parts of the country — and in particular areas where local requirements demand immediate changeover — this exceptional fuel flexibility can be an important factor in determining your overall operating economy.

Ten-second conversion, like 4-pass construction, self-contained design, guaranteed 80% efficiency, is another "plus" feature pioneered by Cleaver-Brooks. It demonstrates Cleaver-Brooks' continuing effort to bring steam users even greater flexibility and reduced operating costs.

If you are considering simplifying your present boiler plant, remember Cleaver-Brooks Combination GAS and/or OIL Fired Boilers. Sizes 15 to 500 h.p. — 15 to 250 p.s.i. Write for complete facts.

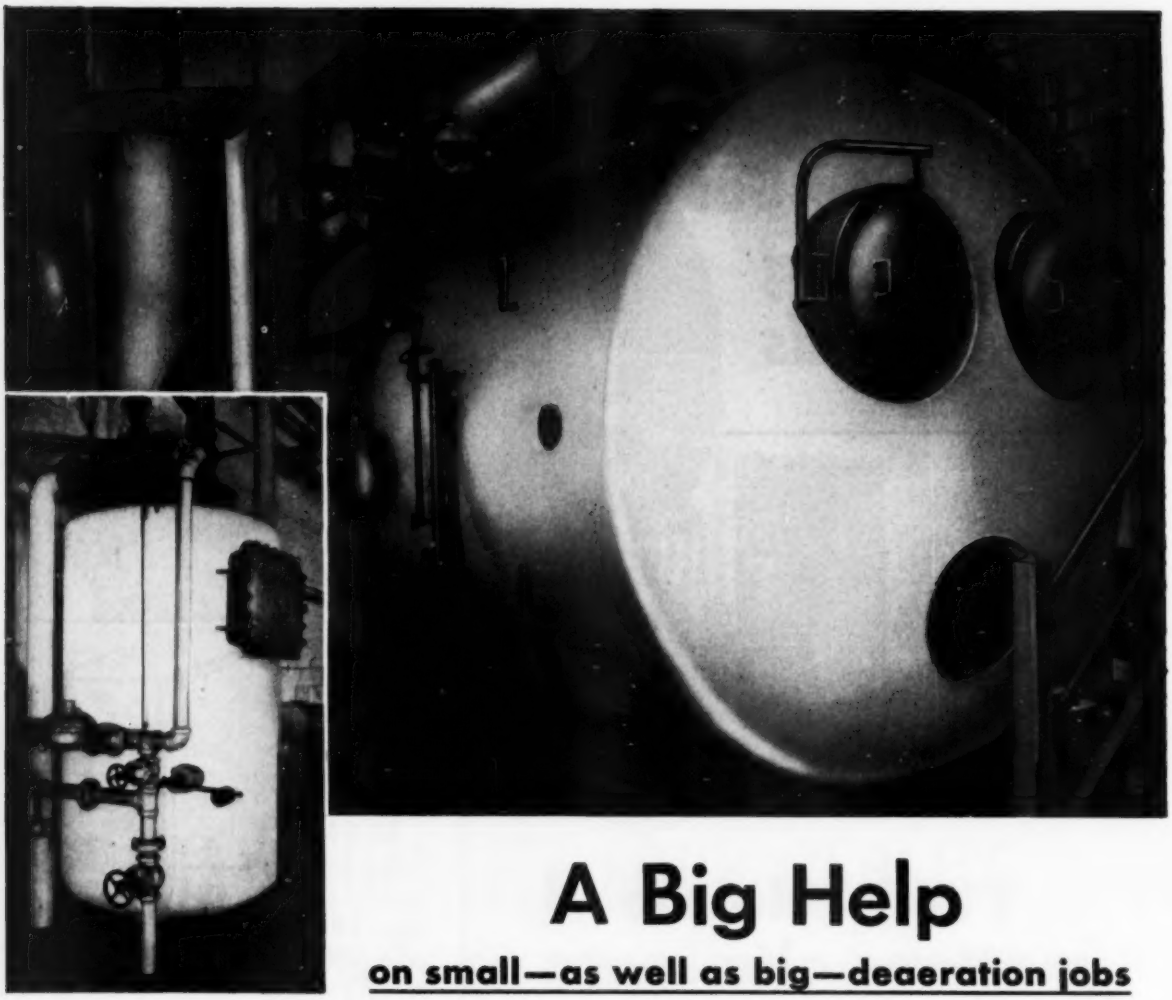
Cleaver-Brooks

Originators of the Self-Contained Steam Boiler

CLEAVER-BROOKS COMPANY

Dept. C-303 E. Keefe Ave., Milwaukee 12, Wis., U.S.A.
Cable Address: Clebro-Milwaukeewis

Builders of Equipment for the Generation and Utilization of Heat • Steam Boilers • Oil and Bitumen Tank-Car Heaters • Distillation Equipment • Oil and Gas-Fired Conversion Burners



A Big Help

on small—as well as big—deaeration jobs

Small deaerators are big business at Worthington! That's why the plant with small-capacity requirements will benefit by getting acquainted with the complete range of Worthington deaerating equipment.

Worthington Gives You All Types, All Sizes

Worthington deaerating heaters and deaerators are built in sizes to handle from a few thousand pounds an hour to over a million. They are tailor-made to fit the particular requirements of each job. Special designs are available for operation with scale-forming water.

Both tray and steam-jet types are made—with external surface-type vent condensers or internal direct-contact vent condensing. They can be furnished for any practical operating pressure—constant or variable—or for vacuum operation.

With a complete range of sizes and types at their fingertips, Worthington engineers can competently recommend the design best suited to *your* requirements.

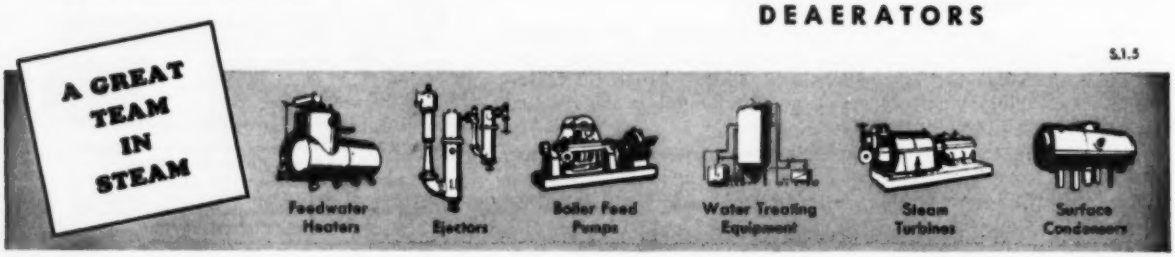
Remember, too, Worthington designs are backed by over 50 years experience in the design and manufacture of direct contact feedwater heaters and over 100 years experience in hydraulic machinery.

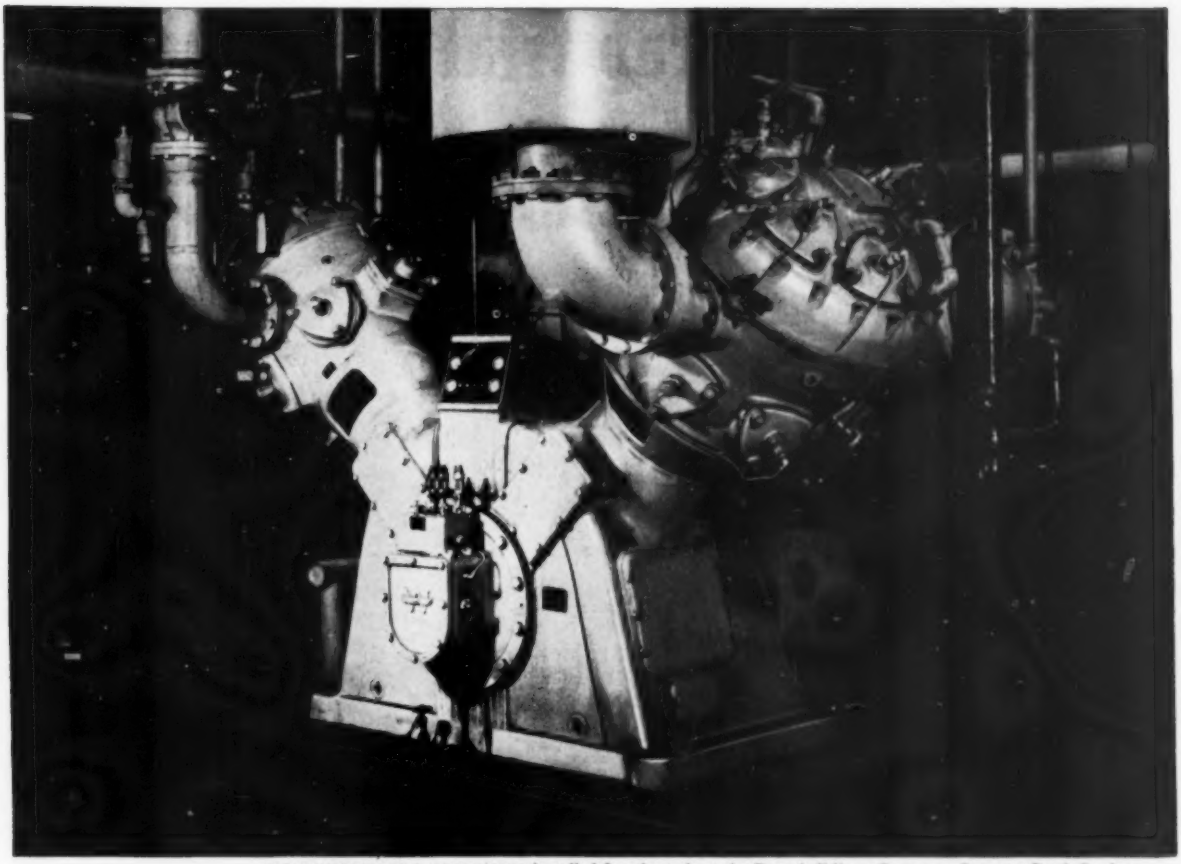
Send your water treating problem to Worthington Corporation, Steam Power Division, Harrison, N. J.

WORTHINGTON

DEAERATORS

S-1-5





WORTHINGTON YC-2 COMPRESSOR installed for plant air at the Detroit Edison Company Conners Creek Station.

Why Worthington customers are repeat customers

At Worthington we naturally welcome "repeat" customers.

We do our best to cultivate them by building the most efficient compressors we can. This is particularly true of the YC-2 compressor. No other air compressor offers greater operating savings.

You save installation costs. YC-2 comes completely assembled—no alignment problems, no erecting engineer needed.

You save power. Worthington Feather® Valve is simplest, lightest, tightest. Maximum number of valves means lower velocities, less friction, and *less power.* 3- or 5-step instantly responsive control matches capacity to the varying amounts of air your shop needs, with lower power consumption at partial load.

You save space. YC-2 requires one-half the space, one-fourth the foundation of horizontal compressors of the same capacity.

You save maintenance. Entire running gear is pressure-lubricated, features anti-friction main bearings.

Write for Bulletin L-667B1B. Worthington Corporation, Compressor Division, Buffalo 5, New York.

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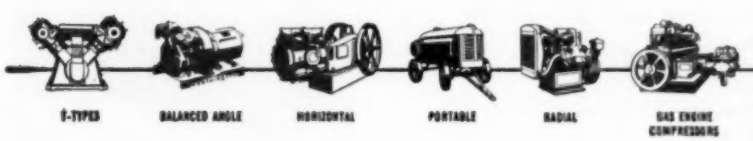


No Other Compressor Will Outperform a Worthington

WORTHINGTON
Compressors

steam trap trial shows how to increase production

Flat-work ironers in Pennsylvania laundry heat up in 15 min. with Yarway traps instead of previous 1½ hours.

West Coast Rubber molding plant cut heating cycle on presses from 15 minutes to 8 minutes by using Yarway traps.

Kettles in New England hospital kitchen reach cooking temperature in 12 minutes with Yarways instead of previous 25 minutes.

Southern textile mill gets satisfactory slasher production for first time due to faster heating-up with Yarway traps.

These 4 plants—each in a different industry—have something in common. Each installed a Yarway Impulse Steam Trap on a trial basis—and after witnessing the production-boosting results, they standardized on Yarway traps.

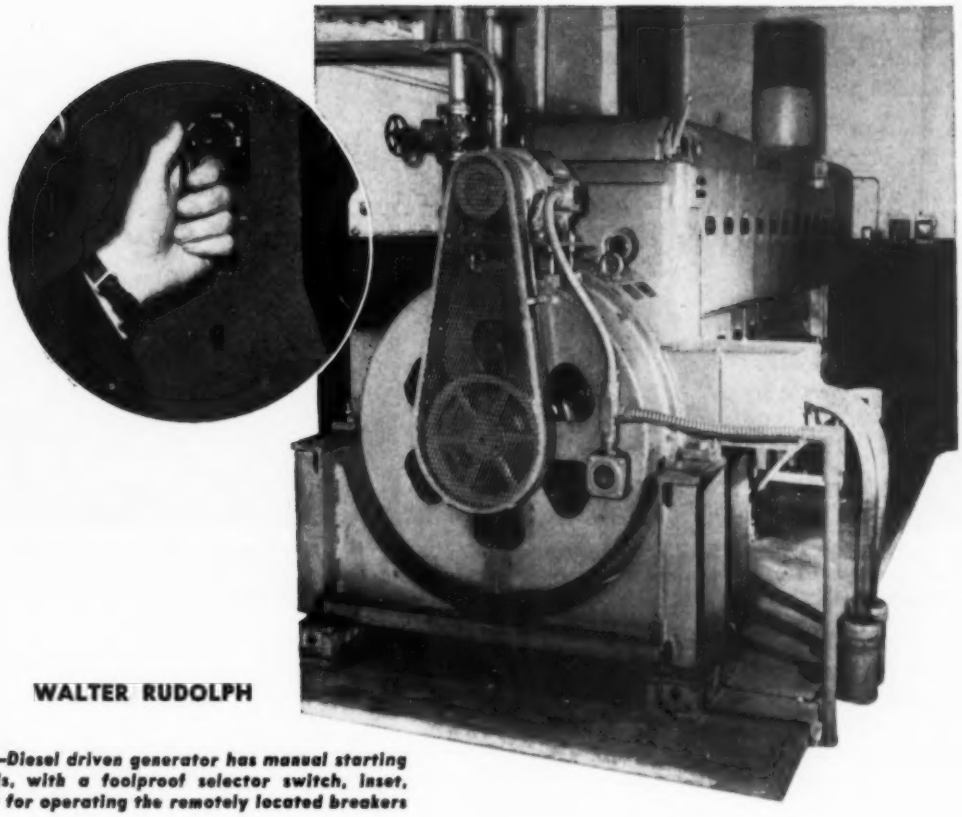
Experiences like these are found in hundreds of plants because Yarways are *designed* to get equipment *hot in a hurry,* and therefore into production fast.

Coupled with other Yarway Impulse Steam Trap advantages like small size, easy installation, stainless steel construction, easy maintenance and low cost—it explains why more than 800,000 Yarways have already been installed.

the steam trap designed with more production in mind

"Please Pass The Condensate" is a new 20-minute, color film on steam trapping for more production. Write now to arrange a plant or group showing.

109 MERMAID AVENUE, PHILADELPHIA 18, PA.



WALTER RUDOLPH

Fig. 1—Diesel driven generator has manual starting controls, with a foolproof selector switch, inset, nearby for operating the remotely located breakers

Emergency Power on Call

Standby generators can be started and brought on the line automatically.* That was unnecessary and undesirable here as in some other plants, but remote control problems in switching power circuits were met and solved.

TWO POWER FACILITIES, for a number of years, were available to what is now known as the Erie (Pa.,) Main Office of the General Telephone Company of Pennsylvania. A number of changes in plant equipment, as well as power availability, and the possibilities of common disasters, prompted this firm to install a standby power plant. Among other features, it has a unique "foolproof" system of controls. Here is the situation:

Erie County Electric Company and Erie Lighting Company formerly supplied power to the Erie telephone exchange and office facilities through two banks of transformers. In the event of one source failing, the other could be leaned upon more heavily.

The two utility power facilities consolidated some years ago under the name of Pennsylvania Electric Company. At the same time, General Telephone was undergoing growing pains to reach its present size of about 19,000 lines in the main office, Erie.

Naturally the telephone plant pushed out its walls in this and that direction, added floors, extended others, becoming a three-story block-long building; and into this building came more new central office switching and other equipment, as well as office facilities.

Management considered these factors, as well as possibilities of a power strike (as had happened in Pittsburgh and other cities), common disaster born of international strife or other causes, and public censorship if all reasonable precautions against failure of telephone service were not taken. It decided that a standby power installation was re-

*"Automatic Controls for Engine Driven Standby Generators", F. E. Reeves, INDUSTRY AND POWER, November, 1952

Fig. 2—This more extensive view of the generator control panel shows a part of the instrumentation as well as indicator lights for circuit breakers

Fig. 3—Switchgear for the power and distribution circuits are located 175 ft from the standby unit, making preventive control circuits very necessary

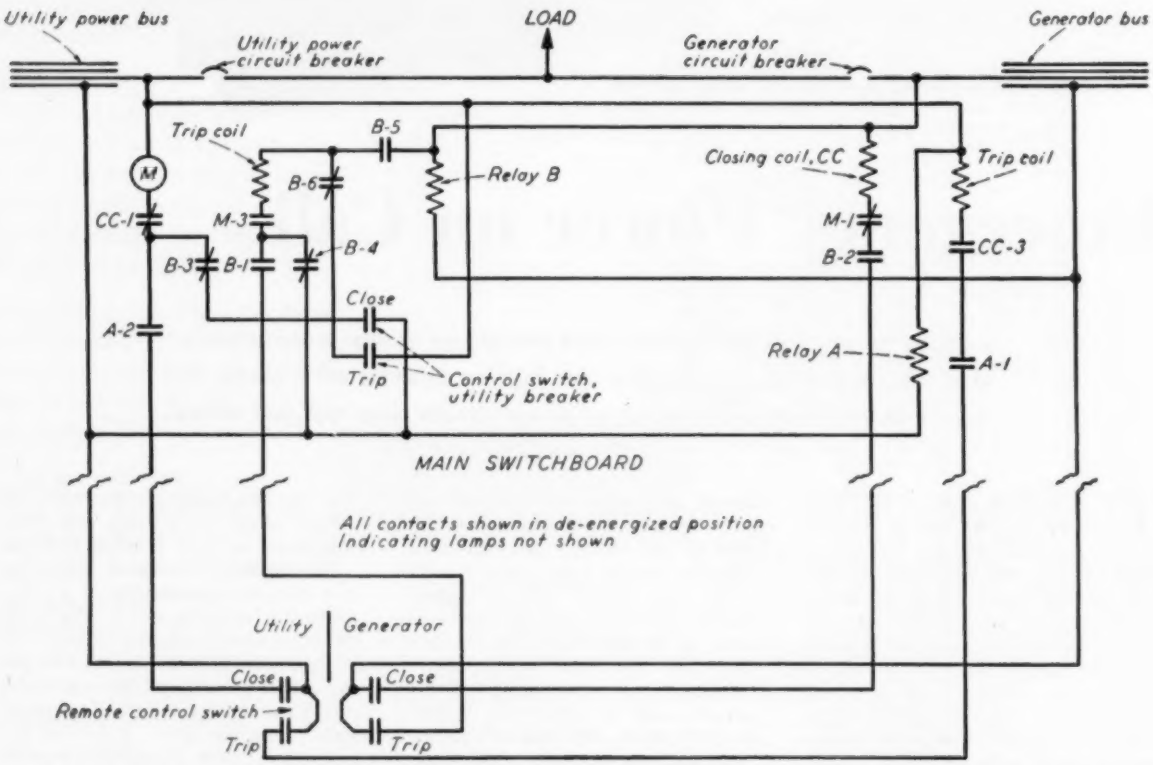


Fig. 4—Control circuit diagram shows how most functions, including interlock for utility breaker remote control, are determined by generator output, allowing operator of the standby unit to control switching of power circuits located at a considerable distance without fear of closing either utility or standby power circuit with other closed

Fig. 5—Door of the utility circuit breaker compartment has an electrical interlock preventing manual closing when standby unit is connected to the lines

Fig. 6—Banks of central telephone exchange equipment, connected circuits and emergency lighting will operate for short periods from the system batteries

quired. C. E. Jones, recently retired vice president and chief engineer, initiated and executed the project, working closely with Alton S. Kuhl, local consulting electrical engineer.

In essence, this telephone plant had been running without standby power of any kind, except for a few hours capacity of batteries. Virtually the entire city could be deprived of telephone service, within a short interval. It was decided that the size of the standby plant would be determined by present, as well as proposed extensions of, the telephone plant and service.

The installed standby plant will allow all normal business and commercial operations of the telephone plant itself to continue, and will also provide energy for charging telephone batteries. The only exception made was in the case of shutting down air-conditioning cooling equipment—compressors, blowers and the like. It was felt that these could be dispensed with, decreasing the load in the event of utility outage. All ventilating machinery otherwise needed continues in full operation. Thus all telephone service facilities really required can continue.

Telephone plant layout posed some standby installation problems. Most acute was the fact that the diesel engine and generator and the main service and distribution panel could not

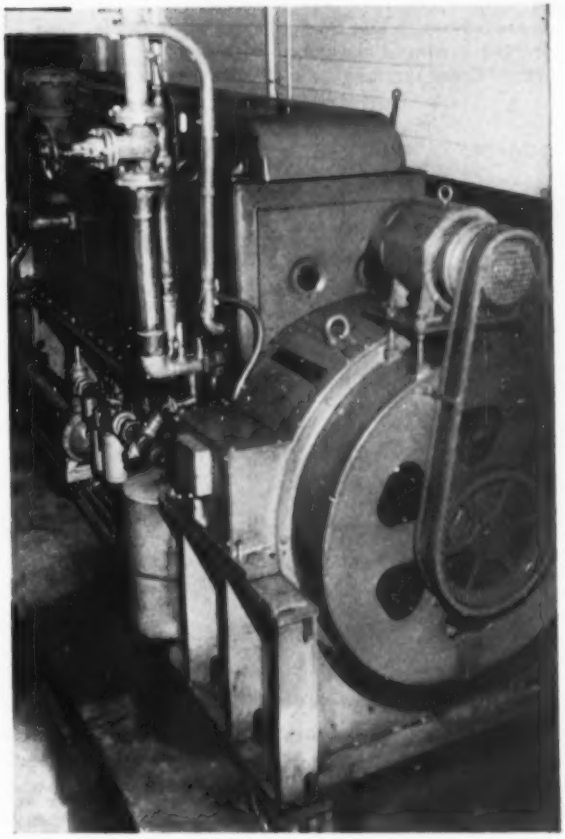


Fig. 7—This view also shows the 280 hp, 720 rpm diesel generator set that provides a 244 kva output to keep all important telephone plant services in operation in event of prolonged interruptions of utility service. The short outages are carried on batteries making it unnecessary that starting and switching be initiated on brief interruptions

be adjacently located. The former had to be placed about 175 ft from the latter in the rear central part of the building, while the main power service and panel were located at the front of the building.

The principal problem, then, was to start and control the standby unit in the generator room. This entailed remote control of electrically operated circuit breakers to transfer the building load to the generator. Therefore, the maintenance man who would start the unit would be in the "driver's seat" and could handle any operating problems that arose in event of power failure from the utility. He could start the generating equipment, see to the proper voltage and frequency, and with one control put the entire system of building circuits onto standby power output.

In any event, electrical engineering of the installation wanted to forestall the possibility of the generator output being paralleled with the utility main. In that case, utility power would feed into the generating circuits, or generated standby power would feed back into utility lines—the resultant complications and system failure goes without saying.

This is the way the installation was wired, so that all eventualities could be forestalled or handled:

The closing coil of the generator circuit breaker obtains its energy from the generated power, and thus cannot close without generator operation, or until the generator can take the plant power load. Also, the tripping current of the utility circuit breaker is obtained from the generator so that it will not trip unless power is being generated. Only two relays were required.

Further, the standby plant operator cannot make a mistake and trip the utility breaker onto the de-energized generator circuit. It is believed most standby control setups do not have this feature.

There are other features worth noting. The door on the utility circuit breaker compartment has an electrically interlocking installation, so that when the breaker is in the closed position no one can open the door. If an attempt is made, the utility breaker trips automatically. This eliminates the possibility of mechanically closing that breaker and paralleling the line. In addition, the door handle has been removed.

In the event of utility power failure, battery current automatically flows to lights in the standby power room through operation of a transfer switch. Thus the operator has lights with which to work while starting the emergency power.

The diesel engine is a 280 hp, 720 rpm unit, coupled to a 244 kva, 120/208 v, three phase, four wire generator. Under city statutes, only 500 gal of fuel oil are stored within the building, in two 250 gal tanks. This capacity will allow 30 hr full load operation. Radiator cooling of the diesel in operation is done through a rooftop installation, directly overhead. The diesel is started with compressed air, stored at one end of the 12 x 33 x 30 ft room. Hour long tests are run weekly; day long, monthly.

General Telephone Company of Pennsylvania in recent years has spent and is spending millions of dollars in modernization and expansion of facilities. One such project will see installation of what is believed to be the largest dry plate rectifier charging plants (1600 amp) for closer regulation of d-c generators in the 50 v telephone system.

LIST OF PRINCIPAL EQUIPMENT

Diesel generator unit	Fairbanks-Morse Co.
Control and distribution panel	Trumbull Electric Co.
Control panel (in generator room)	Lake Shore Mfg. Co.
Oil cooler	Ross Mfg. Co.
Compressed air starter	Diesel Plant Specialties Co.
Cooling system control	Fulton-Sylphon Div.
Various meters	Sangamo Electric Co.
Circuit breakers	General Electric Co.
Voltage regulator	Allis-Chalmers Mfg. Co.

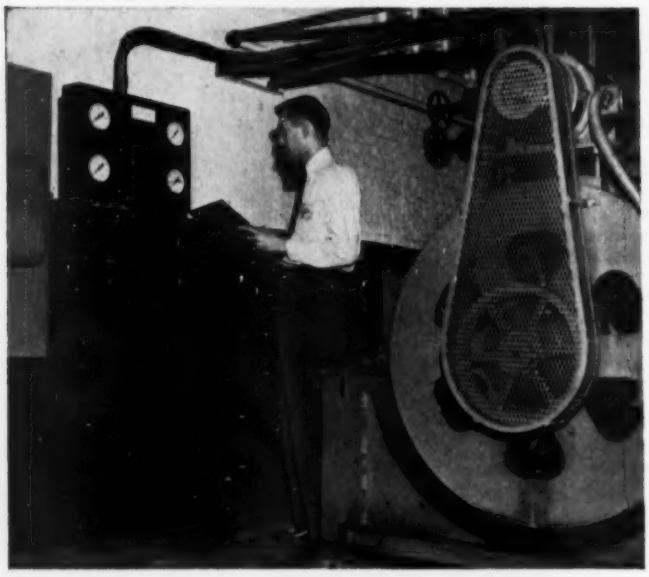


Fig. 8—For information such as fuel consumption and condition of the cooling system, Frank Reese, chief engineer, checks the meters

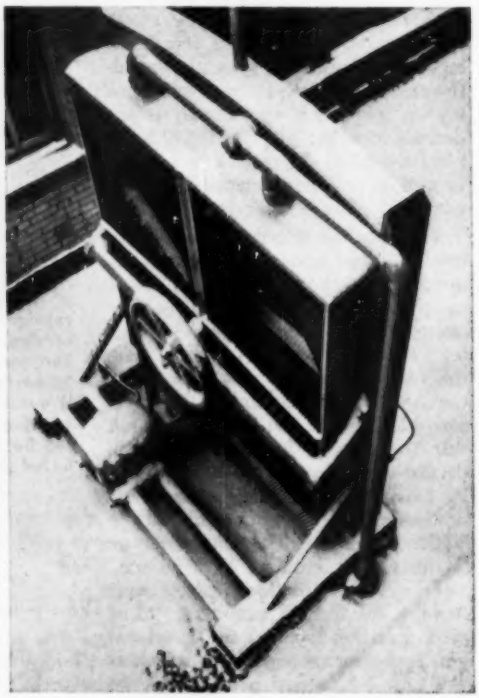
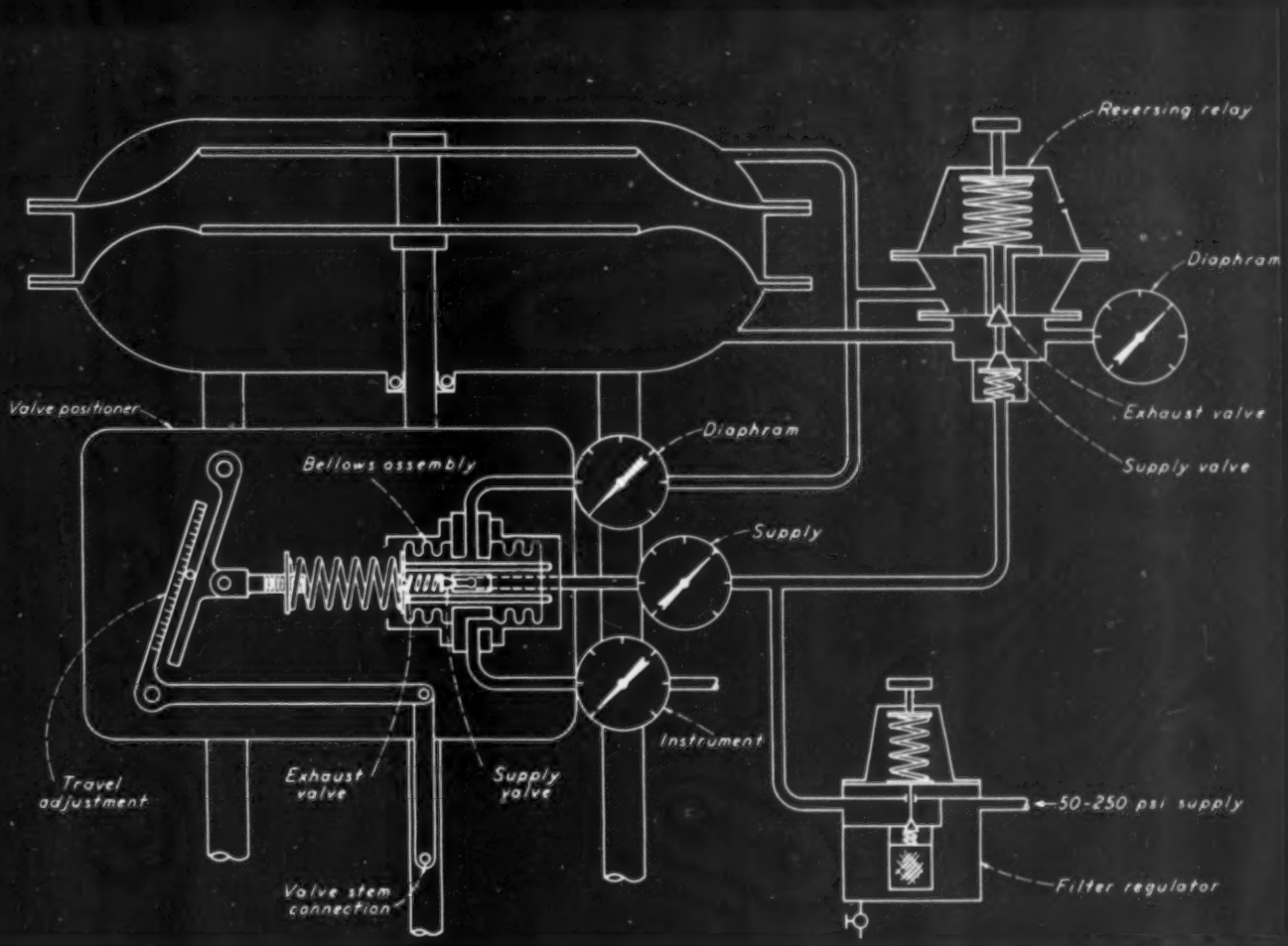


Fig. 9—The logical location for the cooling radiator of the large diesel engine was directly overhead on roof above the standby unit



Special Report to Industry

Control Valves and Positioners

CHESTER S. BEARD, Gas Engineer, Ebasco Services, Inc.

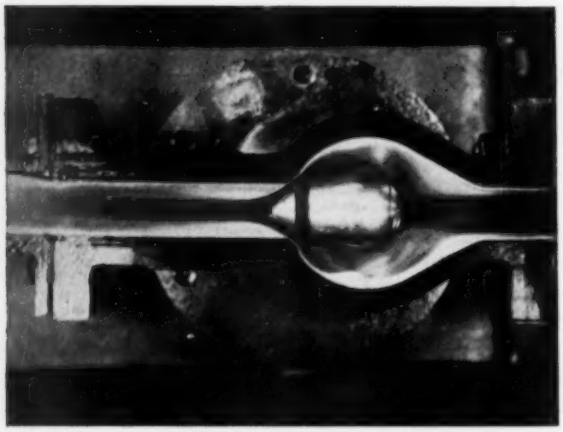
This article has been written to acquaint the engineer with the tools at his disposal for attacking the portion of a control problem dealing with selection of a valve. Emphasis has been placed upon the use of direct-operated valves or regulators. Any further exploration into the use of control valves would become a study of instrumentation. Many fine articles are available dealing with the place of the control valve in the control system. A number of these articles are included in the bibliography.

Every effort has been made to simplify the selection of a valve and some may possibly say that certain problems of selection have been underestimated. This is not the case. Probably 95 per cent of the control valves and regulators may be specified with very little complication, and the selected valve will do its job satisfactorily. The other 5 per cent might require special consideration.

A glance at the bibliography will show that the literature is full of very fine articles on specific phases of the subject of valves, which may deal with many of the problems that make up this 5 per cent. Many of these papers are in the form of reports on technical research now in progress. When the valve application seems to require further study it becomes necessary to take advantage of this wealth of material, and also it becomes advisable to consult with the manufacturer.

Valve design has progressed very rapidly in the past few years. Many of the designs shown are less than ten years old. It is hoped that this summary of the variety of products on the market may start someone thinking who will be able to present unthought of innovations in control valve and regulator design and application.

Flow Characteristics



1 Advantages of streamlining of valve components have been utilized to gain added capacity and efficiency

TABLE 1—PHYSICAL CHARACTERISTICS OF THE IDEAL VALVE

1. Minimum hysteresis in part movement creating variable opening.
2. No leakage between operating areas of the body and topworks.
3. Structural design to give desired pressure and temperature ratings without excessive weight.
4. Easy access to parts subject to wear—preferably without removing the body from the line.
5. Design that allows action of valve to be reversed, or allows flow characteristics or capacity to be varied by change in parts.
6. Self cleaning is desirable.
7. Design including some kind of visible indicator showing how far open the valve may be.
8. Positive and complete shut-off for services requiring same.
9. Design so that unbalanced forces do not hinder the proper operation of the valve.

FLOW of fluids, gases, and pneumatically borne solids in pipes can be controlled in two ways. One way is to vary the differential between the source and delivery point of the flow. The other is to introduce a restriction in the pipe. This summary is confined to the second method.

Valve has come to be a word used to designate any contrivance inserted into a line to create a variable opening that can restrict flow. Usage of the word valve with no defining adjective, like *diaphragm motor*, infers manual operation. A valve for automatic control merely requires some kind of topworks with which to set the opening of the valve to obtain the desired flow condition. In describing types of automatic valves, the first interest is in the numerous and ingenious body designs that have been devised to give this variable opening affect.

In observing the innumerable body designs, it is evident that each designer was making an effort to overcome one or more of the weaknesses in the existing equipment. Physical characteristics of the ideal valve are listed in Table 1 to give the reader a basis for comparison of the various bodies pictured and to determine those that are important for a particular application.

In addition to these features of the mechanical design, there are two very important requisites that are dependent upon design but bear additional discussion. These are the flow capacity and flow characteristics of the valve.

Flow capacity of the valve is the volume of liquid, gas, or steam that may be put through the valve under the existing conditions with the valve in the open position. Inasmuch as a venturi section has the least pressure loss, it would seem that a valve designed to give a variable venturi throat would have the greatest flow capacity. This is true, but the mechanical difficulty and the necessity for other characteristics, as well as capacity, have precluded this approach to valve design. Fig. 1 illustrates streamline design.

Maximum flow capacity is made up of many factors beside the efficiency of flow just mentioned. Difference in energy level at the valve inlet and outlet type of fluid flowing, viscosity and gravity of the fluid, and velocity all contribute to the capacity. Utilization of the flow coefficient C_v has offered a standard method of comparing valves to determine the correct one for the particular service. Flow coefficient of a valve is the volume of water in gpm that will flow through the body with a one pound drop in pressure. Maximum flow coefficient is the maximum flow that will be reached by opening the valve. It is interesting to note the wide C_v factor range that exists for valves of the same size—even supposedly of the same design, Table 2, C_v

TABLE 2—C_v COMPARISON TABLE

Valve size, inch	#1	#2	#3	#4	#5	#6	#7
½	7	—	4	—	—	4	6
¾	11	9	6.3	8	—	7.5	9
1	17	14	10	13	19	12	13
1¼	26	21	16	18	16	22	19
1½	39	34	25	28	23	33	26
2	62	54	40	45	45	50	50
2½	99	92	63	72	63	75	72
3	150	132	100	100	90	100	105
4	225	181	160	165	160	200	166
5	340	310	—	—	—	—	250
6	500	350	360	360	360	420	345
8	720	600	640	640	640	750	670
10	1200	1200	1000	1000	1000	1250	990
12	1600	1600	1440	1440	1440	1750	1300
14	—	—	—	1960	1960	2500	—
16	2900	—	—	—	—	3250	—

Based on equal per cent characteristics, using higher values for V-port or contoured plugs, top and bottom guided. From manufacturers slide rules and tables.

factor usage is based upon faith that the manufacturer has run tests on his products so that his published data may be used with confidence. Test data are available for most of the equipment on the market with the exception of the very large valves.

The following equations make it possible to apply the C_v factor to determine capacity under the conditions existing in a particular application.

To determine capacity when C_v and flowing conditions are given:

Liquid,

$$V = C_v \frac{(P_1 - P_2)^{0.5}}{G^{0.5}}$$

Gas,

$$Q = 61 C_v \frac{[(P_1 - P_2)P_2]^{0.5}}{G^{0.5}}, \text{ (60F)}$$

$$Q = 1390 C_v \frac{[(P_1 - P_2)P_2]^{0.5}}{(GT_f)^{0.5}}, \text{ (Flow Temp.)}$$

Steam,

$$W = 3 C_v [(P_1 - P_2)P_2]^{0.5}$$

Where:

V, flow, gpm
Q, flow, cfh at 14.7 psi and 60F
W, flow, lb per hr
P_1, inlet pressure, psia (14.7 + psig)
P_2, outlet pressure, psia
G, specific gravity
T_f, flow temperature, F abs (F + 460)

To determine C_v with the following conditions given, the equations appear in a different form:

Liquid,

$$C_v = \frac{V G^{0.5}}{(P_1 - P_2)^{0.5}}$$

Gas,

$$C_v = \frac{Q G^{0.5}}{61 [(P_1 - P_2)P_2]^{0.5}}$$

or

$$C_v = \frac{Q (GT_f)^{0.5}}{1390 [(P_1 - P_2)P_2]^{0.5}}$$

Critical flow of compressible fluids, such as gas and steam, limits the capacity of the valve. It becomes very evident in practice and may be determined by complex thermodynamic calculations, that the velocity of the fluid through an orifice reaches a maximum and that further pressure differential will not increase the velocity. This critical velocity occurs at a slightly varying difference in pressure ratios. It may be shown that above critical velocity (when the differential pressure is greater than one half of the inlet pressure) capacity formulas should be:

Gas,

$$Q = \frac{30.5 C_v P_1}{G^{0.5}}$$

or

$$Q = \frac{695 C_v P_1}{(GT_f)^{0.5}}$$

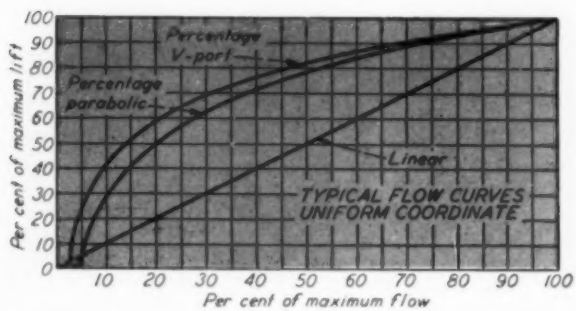
Steam,

$$W = 1.5 C_v P_1$$

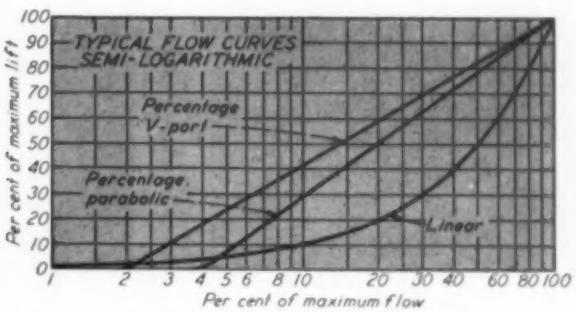
In presenting this C_v method of calculating valve capacities, it is fully recognized that there will be inaccuracies in, for example, use of the C_v factor for selection of a small valve for water flow with a differential pressure of possibly 10 psi, and the use of the C_v factor to select a 10 in. valve for gas with 100 psi drop. Precise selection of a valve, which has the maximum flow rate desired under the conditions of its use, is only possible by using a flow coefficient obtained under very similar conditions. For large valves with large flow rates, this experimental work becomes impractical. In due fairness to the manufacturers, we must say that some of them have obtained coefficients for a portion of their line of valves. However, the engineer has difficulty in determining what portion of the sizing charts may be the result of tests, and what portion may be extrapolated or calculated. In most cases, selection of the expected operating conditions used in choosing a valve is much less accurate than the C_v coefficient.

If the flow capacity of a valve is determined at a number of positions, from closed to maximum flow, a plot of the C_v values may be made to show a flow curve or flow characteristic of the valve. Glancing at the figures shows that valves may be purchased with a wide variety of flow characteristics, and construction of some valve bodies is such that flow characteristics may be varied by the shape of the plug or piston. The following descriptions are given to present the different types of valve bodies in a manner that should be useful in selecting a valve for a service. In presenting these characteristics only the body is considered, although correct selection requires consideration of the actuating mechanism or topworks and the means of measuring the variable to be controlled.

Two basic methods of plotting flow characteristics are in use. Each one has advantages for analyzing flow behavior. The first and most obvious way to prepare a curve of flow characteristics would be to use flow rate as the abscissa and percentage stem travel or plug movement as the ordinate using uniform coordinates for the plot. The actual lift or plug movement in inches may be substituted for the per cent of full lift to give a very realistic picture for one particular valve. The comparison of data for two valves may become confusing when using this last approach. For example, ¼ in. travel for one valve may give 90 per cent of full flow but only 12 per cent for another style. The use of actual stem travel is, nevertheless, important for analyzing a family of valves with the same maximum lift or as a comparison method of obtaining one particular flow rate with various valves. The second means of showing flow characteristics takes advantage of the logarithmic scale for the flow rate and the uniform scale for the per cent of full opening. The logarithmic scale has a very decided advantage in that the percentage accuracy of any number whether 1.2 or 12 or 12,000, is the same. In plotting flow, two cycles of the scale are used; one from 1 to 10 the next from 10 to 100. This permits plotting of flow characteristics at the very critical low lifts just as accurately as through the upper range. A group of characteristics are plotted in Fig. 2 and 3 by both methods for comparison.

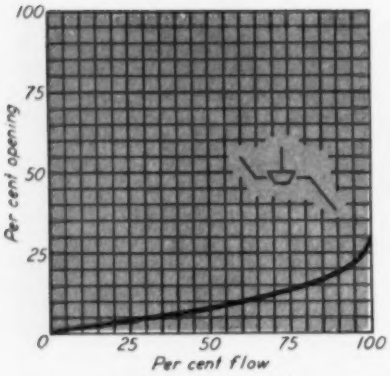


2 Uniform coordinate method of plotting valve characteristics gives comparison between flow and stem travel

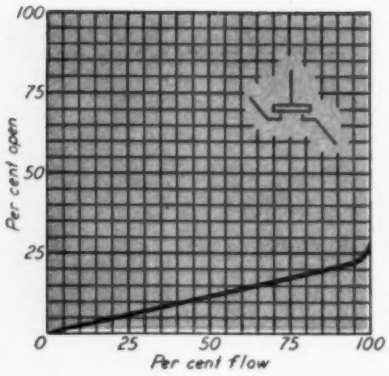


3 Logarithmic scale has an advantage in that percentage accuracy of numbers between 1.2, 12, or 12,000 is same

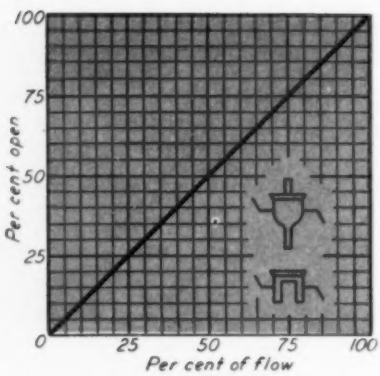
Valve Body Design



4 Quick opening valve has straight line relation through 70 per cent of travel



5 Quick opening disc valves maintain straight line flow until fully open



6 Linear flow means that per cent flow equals per cent of valve stem travel

Quick Opening or Poppet

This valve, Fig. 4, maintains a straight line relation between per cent flow and per cent travel through about 70 per cent of its travel. Full capacity is reached with very short stem travel, because the annular space between the seat and plug becomes equal to the area of the seat orifice with a travel of only about ¼ of the seat diameter. Although good positive shut-off or lock-up may be obtained with this style, using a well lapped plug and seat, the soft leather or rubber seat should be used when positive lock-up is required.

This type of valve is used extensively in a self actuated control valve commonly known as a pressure regulator. It is particularly adaptable to on-off control or in systems with a constant pressure drop. A constant pressure drop system may be one in which constant flow is being maintained from a surge tank to a fractionating column of constant pressure. The valve is not used for high pressure drops. The range of pressure drop may be increased by top and bottom guides. The addition of this lower stem will decrease the C_v but will not appreciably change the plot of the characteristic.

Quick Opening Disc

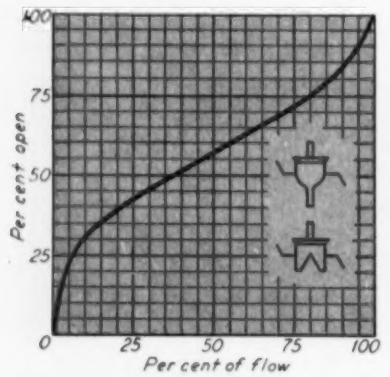
Valves of the quick opening disc type, Fig. 5, will maintain a straight line characteristic until very close to full opening. Stem travel for full capacity is practically the same as the beveled poppet type. This valve will give positive lock-up by using a soft face on the flat plug. The valve will continue to lock up as irregularities of the seat face are counteracted by the soft face of the plug. A majority of the gas regulators are of this type.

Linear Ports or Plugs

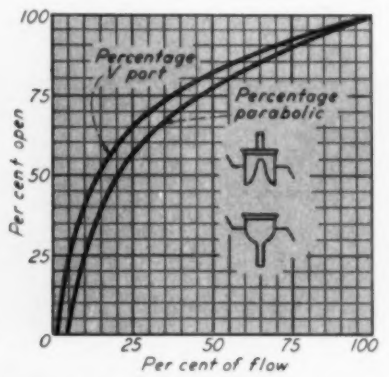
Linear flow characteristic means that the per cent flow is always equal to the per cent of valve travel. Thus, the uniform plot is a straight line, Fig. 6. This characteristic may be obtained by rectangular ports or by a shaped plug. This type of inner valve may be used when a large portion of the system pressure drop may be taken across the control valve. The shaped plug should be used for maximum capacity as the curves show that for a given size of body, the full open flow of the plug is greater than the rectangular ports.

V Port or Parabolic Plug

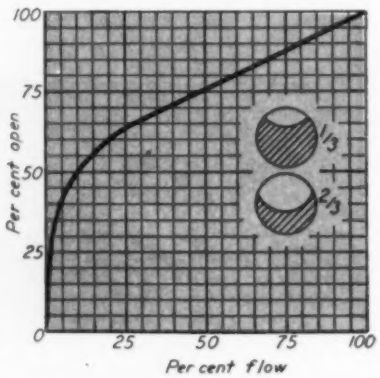
Parabolic flow characteristic, Fig. 7, may be obtained with a V ported valve. This is because the area of the triangle being covered, starting at its vertex plotted against the altitude or stem travel, is parabolic in shape. The contour of the parabolic plug has been designed to give a similar curve. The V port came early in the advance of valve



7 Parabolic flow characteristics are obtained with a V ported valve plug

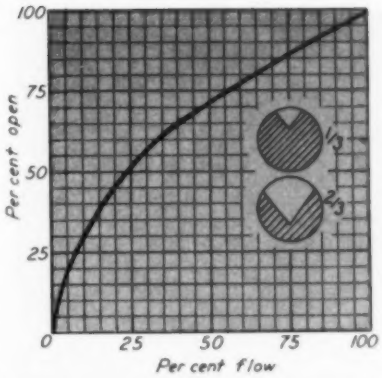


8 Equal percentage characteristics produce constant rate of change in flow



9 Plug cock valve flow approaches linearity during first half of opening

port design, and it offered the advantages of high lift, which allows much easier positioning of the plug for a given flow condition than does the quick opening poppet. This is evident because the length of the V port or parabola may be as much as the diameter of the seat, rather than ¼ of the diameter as in the quick opening type. These valves may be designed for low lift with the same characteristic occurring within a shorter travel. However, this design lacks rangeability, which is the ratio of maximum to minimum flow over which the usable flow characteristic exists. The curve shows that good control is difficult after the valve is about 80 per cent open.



10 Flow characteristics of restricted plug cock show uniformity of curve

Percentage Characteristic

V port valves and the parabolic plug valves may be machined to give a wide variety of flow characteristics. The equal percentage, or logarithmic characteristic, was developed in an effort to obtain good control over a wide range of flow and pressure changes. By definition, *a control valve with an equal percentage logarithmic flow characteristic, produces constant rate of change in flow for a unit change in lift at constant pressure drop.* By this definition, a 10 per cent change between 10 per cent and 20 per cent, would have the same percentage affect upon the flow, as the same change between 60 per cent and 70 per cent open, would have upon the flow rate at 60 per cent open. This may be seen on Fig. 8. More has been written about the pros and cons of this valve than any other phase of the subject of control valves and regulators.

Needless to say, a large portion of the control applications found in chemical plants, refineries, and manufacturing plants deals with systems in which the variables involved in the process change, and the controlled liquids or gases fluctuate in a non-linear manner. Non-linearity occurs when the line pressure drops vary considerably from low flow to maximum demand. Under these conditions the pressure drop across the valve may be a small percentage of the system drop at maximum flow but a large percentage at small flows. The equal percentage changes of the valve being discussed make it possible to control adequately a wide range of these changes with one size of valve. The foregoing statements are academic, as tests have shown that many so-called logarithmic valves do not give true characteristic curves due to inaccuracies in construction. The products of reputable manufacturers do not deviate enough to be discernible in practice.

Comparison of the equal percentage plug to the V port shows that the plug is less susceptible to erosion, less apt to stick, and in most cases less apt to create high frequency noise. The weight of large sized plugs becomes excessive, although the plugs are now being made as a partial shell to minimize weight.

Piston Valve

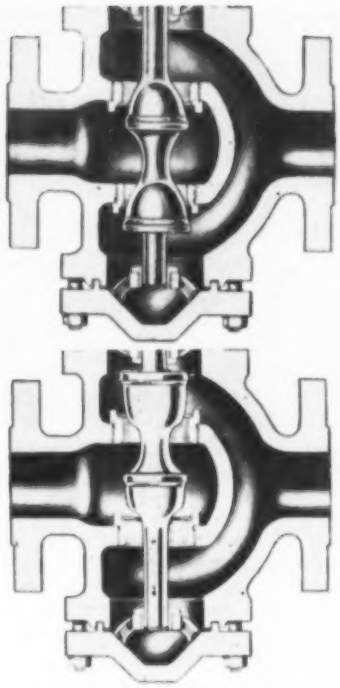
Piston valves consist of a hollow cage, which is moved within the seat area. A beveled ring may be machined at the top of the piston to close on the seat to give more positive shut-off. The flow is through ports throughout the cage. A variety of characteristics may be obtained by the shape of the ports. The design of this valve offers very good guiding. Consideration must be given to the temperature of the flowing medium so that expansion will not cause excessive sticking.

Plug Cock (Full Opening)

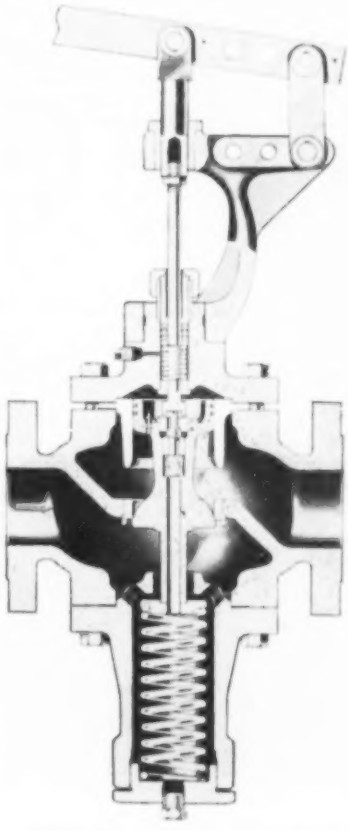
Full opening plug cocks, Fig. 9, require a 90 deg turn for full opening. The plug cock has not been used for pressure or flow control as extensively as some of the other designs that are depicted. This is due to the relatively high power needed to position the plug, thus necessitating a piston or motor rather than a diaphragm. The flow characteristic, which is observed by analysis of the area of two converging circles, approaches linearity through the first half of its opening. The plug cock has been employed successfully for velocity control and for rate of take-off from the transmission main of a water system. Development of very positive strong positioning devices has made it advisable to consider this type of valve for control.

Plug Cock (Restricted)

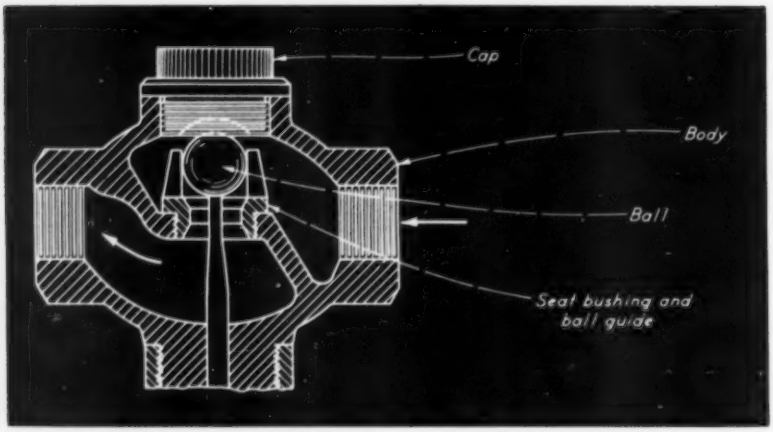
By far the majority of cocks in use are designed with an opening closely resembling a rectangle, Fig. 10. These have not been used very much as control valves. This would seem to be be-



11 Balancing valves have two plugs and high side pressure aids positioning



12 Balanced piston for second plug makes balanced single seated valve



13 The ball valve is a unique design that accomplishes good seating. The ball moves within guides and tends to last indefinitely due to constant movement

cause of the power requirements and the availability of so many superior control valves. Suitable operators have been added to cocks in existing gas systems when revisions have been made in the system requiring pressure control.

Balanced Valves

Very early in the history of control engineering, designers realized that the force necessary to position a single-seated valve could be decreased by using two plugs on separate seats on a common stem, as in Fig 11. By doing this, the high side pressure would be exerted under one plug and on top of the other. This would also be true of the reduced pressure side. The relation of the areas exposed to the pressures cause an unbalance, which is much less than that of the single-seated valve. Utilizing two port openings, now may be made to practically double the capacity of the valve. The only limiting factor is the ability of the valve body to carry the additional flow. The flow characteristics of the double-seated valve are the same as the single-seated valve of comparable design. Although the two metal plugs on a common stem may be successfully machined or lapped into two seats to give positive shut-off, wear and temperature conditions contribute to leakage after the valve has been put into service. For applications requiring *lock-up* of pressure at no flow, a soft ring is utilized that seats in the closed position, Fig. 12.

Although the double seated valve is called a balance valve, there can be both torsional and vertical forces of sufficient magnitude to cause operational difficulties. Tests have shown that the skirted V port valve develops large torsional forces when partially open with high pressure drops and large mass velocities. The throttle plug valve develops large vertical forces, which tend to close the valve under similar conditions. Careful study of design factors contributing to these conditions permits some manufacturers to minimize these affects without changing the flow characteristics.

Balanced Single Seat

A decrease in the power that is necessary to operate a single-seated valve has been accomplished by design similar to the balanced double-seated valve. The upper plug is simulated by a piston as shown in Fig. 12. Equal pressure is exerted on the bottom of the piston as on the top of the single-seated valve. The downstream pressure is brought in to the top of the piston through a port, thus equalizing the static pressure exerted on the bottom of the single-seated valve. An equalizing spring assists in establishing balance. This design does not alter the flow characteristic of the valve. The characteristic is still dependent upon the shape of the plug.

Streamlined Plug

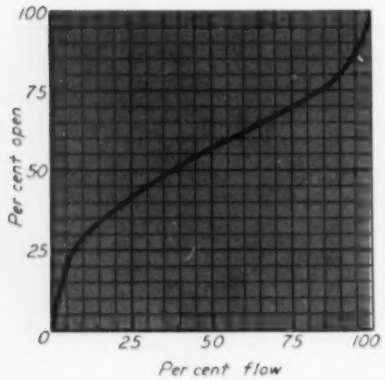
This plug was developed to give added flow capacity. The flow characteristic is similar to a quick opening valve, because the head of the plug opens as an annular space just like the globe valve. The streamlined tail and straight flow through the outlet of the body are able to minimize turbulance, as well as to decrease the unbalance across the plug, Fig. 1.

Ball Valve

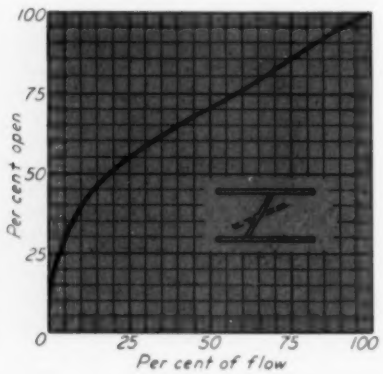
Unique design to accomplish good seating and long life is shown in Fig. 13. The valve is a ball, which is lifted off the seat by the stem and returned to the seat by the flow through the body. This valve usually is installed with the stem protruding down. The ball moves within the guides and tends to last indefinitely due to constant movement, which exposes a new surface for seating.

Dam and Disc (Saunders Patent)

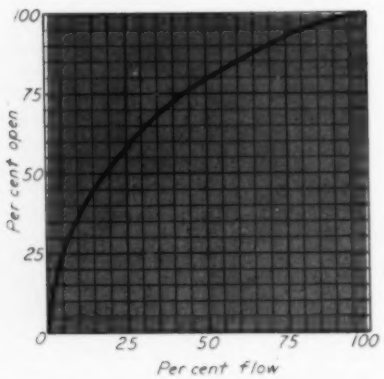
Body construction of this control valve consists of an upstanding weir. Closure is obtained by impressing a dome-shaped diaphragm upon this



14 Dam type valve has flow characteristics which resemble linear flow



15 Butterfly valves offer a low pressure drop in the wide open position



16 Flow characteristics may be varied considerably by the V port shape

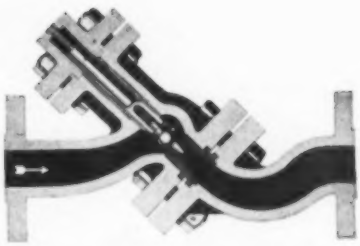
dam. The design of the body of the valve lends itself to the use of many materials including corrosion resistant metals and plastics. The diaphragm may be made of any of the synthetic rubbers that can be molded. Flowing liquid does not come in contact with any part except the inner surface of the body and the lower portion of the diaphragm. The valve is self cleaning so that it can be used with sludges and high consistency stocks.

Diaphragms may be operated by all standard topworks with consideration given to the power required to obtain and hold complete shut-off. The characteristic, which closely resembles a parabolic plug, is a fortunate circumstance, as the valve was designed for large internal area-ratio to pipe size, complete shut-off, and corrosion resistance. Reference to Fig. 14 showing a typical flow characteristic, shows a linear relation between about 25 and 75 per cent travel. With this short travel, about 80 per cent of the flow variation is obtained. The valve has a wide range of application, but pressure limits of 150 psi for smaller valves and 65 psi for 12 in. or larger are recommended. Operating temperatures are dependent upon the characteristics of the diaphragm material.

Butterfly Valve

Throttling action of a butterfly valve is accomplished by a damper or vane, which may be rotated by a shaft extending through packing to the outside of the body. This damper or vane is inserted in the flow steam. In the past, this valve has been used to vary the flow of large quantities of low-pressure air. The very low pressure drop in the wide-open position makes it valuable for this service. A butterfly valve designed to close in a vertical position rather than at an angle is much less expensive to manufacture due to the use of a circular rather than an eliptical damper. The angle type may be made to shut tighter with less chance of sticking.

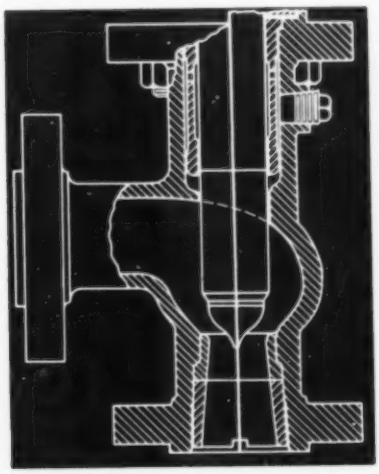
Very large unbalance forces set up at certain points in the travel of the flapper and excess leakage have, until recent years, confined the use of the butterfly valve to low pressures. Careful design has extended the usage by the inclusion of ribbed dampers, heavy

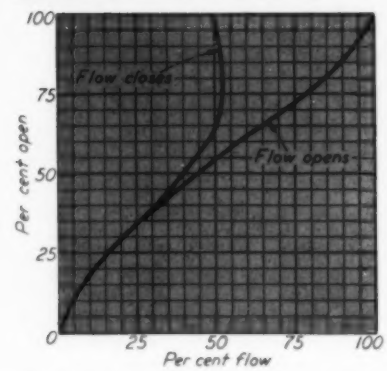


17 Flow causes a minimum of erosion. Valve useful for sludge or vapors

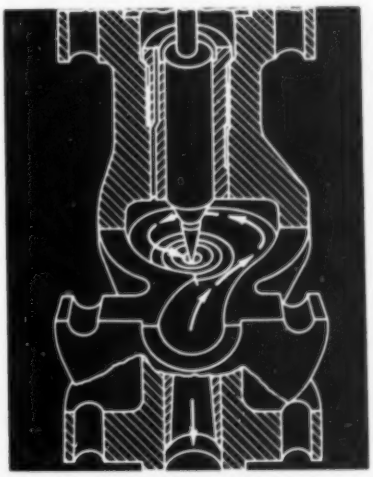
shafts, beveled vane edges, and in some cases beveled vane with rubber lined bodies. The fact that torque varies as the cube of the diameter, shaft thrust varies as the square, while both vary directly with pressure differential makes it evident large diameters and large differential pressures are limited by structural requirements.

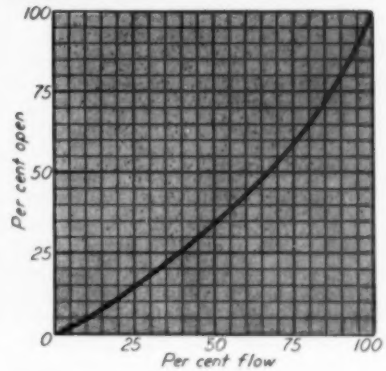
Torque tends to close the valve, and this torque reaches a maximum when at a position of about 80 degrees of opening. The design difficulties have led to acceptable differential pres-



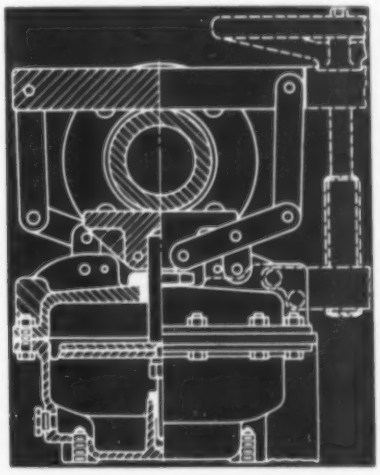


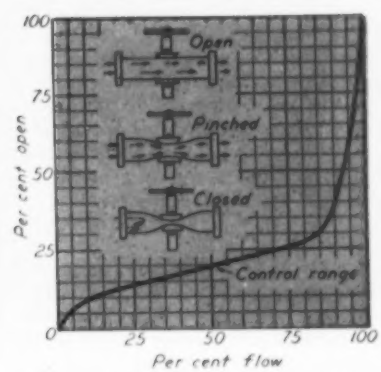
18 Angle valve, with venturi throat, has wide usage for high pressure drops



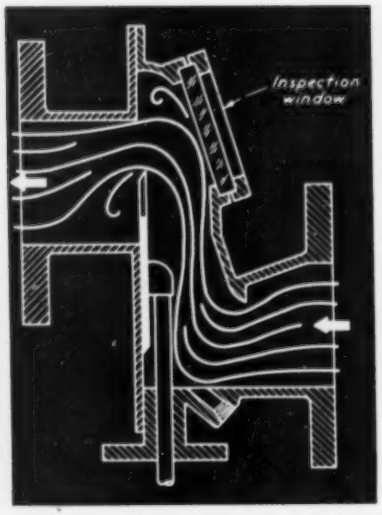


19 This valve has a uniform flow and is designed for flashing condensate

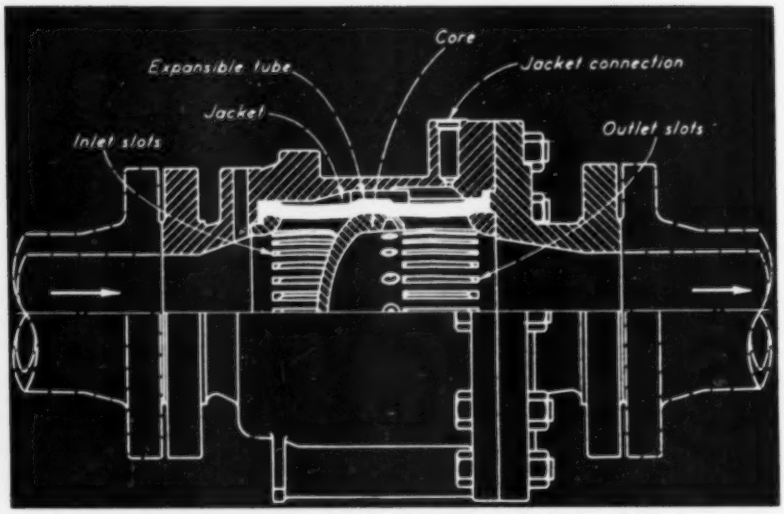




20 Rubber pinch valves are adaptable for control through limited range



21 This valve is designed to handle paper pulp fibers and slurries



22 Synthetic rubber sleeve envelops the cage in this valve. Annular space in valve body allows the tube to expand to permit flow past center barrier

sure limits as high as 100 psi for gas and 50 psi for liquids on an 8 in. valve, but only 15 psi when reaching the 30 in. class. The supplier's recommendations for this product are very important in selecting these valves. For large sized valves, the price of the butterfly valve as compared to other types warrants serious consideration of its use.

Reference to the curve, Fig. 15, shows that above 15 per cent open point, the butterfly valve flow characteristic is very similar to the percentage V or parabolic plug valve.

V Port Butterfly

V ported butterfly valves were designed primarily for metallurgical furnace control. The valve consists of two V ported surfaces engaged by a close fitting butterfly vane. The flow characteristics may be varied by the shape of the V port Fig. 16. As compared to the conventional butterfly valve, this valve gives much better control. This is because greater flow change per degree of angular travel is obtainable at the high flows when this change is required most. At low rates in order to gain greater sensitivity for a flow change, a greater angular movement is necessary. This valve approaches the operation of a globe design with its relatively high pressure drops in the open position as compared to the butterfly valve.

S Valve

This valve is so named because the flow simulates an S in passing through the valve, Fig. 17. This flow causes a minimum of erosion and is useful for sludges or for vapors, which contain entrained liquid. The valve must be single-seated, and the flow characteristic is dependent upon the shape of the plug. The designers of this body are cognizant of mechanical difficulties in maintaining the proper plug-to-seat relationship when both are on an angle and widely separated. They have, therefore, furnished a large-diameter strong stem and sufficient bearing length. These factors, and the additional fact that the valve is usually used with high pressure drops, require selection of a precise and powerful operating mechanism.

Angle Valve

Angle valve design with a venturi throat in the discharge, Fig. 18, has found wide use for extremely high pressure drops, for erosive and corrosive service, and for flashing fluids and sludges. The valve is of necessity single-seated and requires a very sturdy stem with a long guide. The inlet to the body is designed to guide the flow to the outlet venturi nozzle. The valve in Fig. 18 would obtain the minimum turbulence, while the one illustrated in Fig. 19 approaches the problem in a very different manner. This valve, designed particularly for flashing condensate, minimizes direct impingement by circular flow. A uniform flow characteristic is obtained.

Rubber Pinch Valve

This valve applies the same method to large tubes that is applied to laboratory rubber hose by a pinch clamp. It may be employed for pulps and abrasive liquids because the flowing medium does not contact any operating parts. The valve will shut off on coarse particles, and it will operate in freezing weather, which might cause frost troubles with the metal valves. Although this valve was not normally used as a control device, it has now been designed with an automatic operator, Fig. 20. Reference to the curves shows that the characteristic between 5 per cent and 35 per cent open may readily be used for automatic control. The rubber sleeve has been designed with recesses in opposite sides. These act as hinges during compression. The rubber sleeve offers no restriction in open position, so that full capacity of the valve is very high.

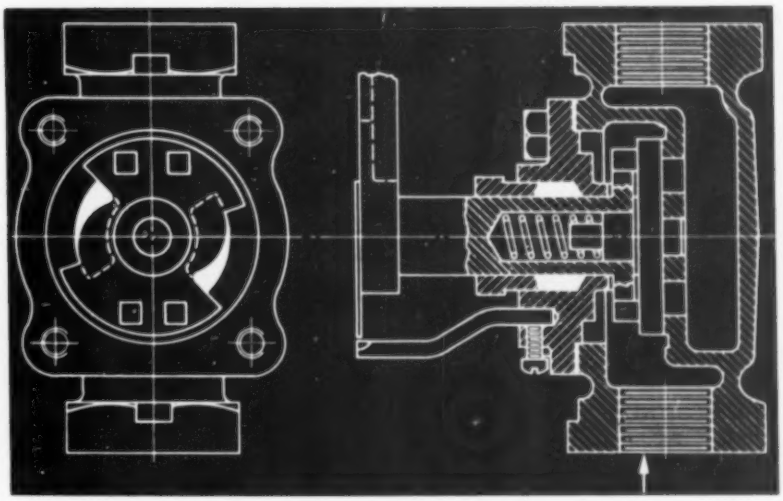
Paper Stock Valve

This valve was designed to handle pulp fibers and slurries. It is a slide valve with a variable diamond-shaped opening, with the flow pattern as illustrated in Fig. 21. Comparison of the small slot, when a globe valve approaches its seat, to the diamond-shaped opening of equal area, will show the advantage of the diamond or pear shape as an opening for liquids which contain solid material. This valve is constructed with a lip in the inlet to cause turbulence, which precludes material becoming lodged in the body. An inspection window allows observation of flow at the seat. The slide valve requires no guides, as it has small fingers to hold the gate in position against back pressure. Slide valves are moved by pneumatic cylinder.

Rubber Sleeve Valve

This type of body consists of a circular slotted cage with a barrier in the middle, Fig. 22. A synthetic rubber sleeve envelops this cage. An annular space in the valve body allows the tube to expand to allow flow past the center barrier. The valve is closed by introducing pressure to the

23 Rectangular port rotary piston has a wide variation in flow capacity



24 Rotary disc valves contain a rotor that opens and closes a series of ports. The flow characteristics are similar to a true V port valve

outside of the tube in the annular space. Flow characteristic may be varied by a pilot or relay to control the pressure impressed upon the sleeve in order to accomplish the closing.

Usage of the flexible tube has several advantages. The sleeve will not stick, and it does not slam or chatter, as a metallic valve does at times. The sleeve will envelop foreign matter to close tightly. Within limits of temperature and chemical attack, the sleeve resists wear and erosion. The valve usually is operated by the introduction of the flowing fluid from the high side of the valve although an external source of pressure may be used. One of the various pilot systems is used for control. Construction allows ease of replacement of the flexible sleeve. Pressures required to open fully are 10 psi for the series 15-1¼ in. and 4 psi for the 12 in. Series 30 valves require 25 psi for the 1¼ on down to 10 psi for the 12 in.

Adjustable Rectangular Port Rotary Piston

Wide variation in flow capacity is obtained by the rotary valve in Fig. 23. The opening and closing are obtained by rotary motion of the piston. Any portion of the port area may be utilized by adjustment with the handwheel.

Rotary Disc Valve

Many types of slide valves have been developed. One type, Fig. 24, consists of a disc with openings, which are rotated to open and close the ports of the seat. Flow characteristic is similar to a true V port. This valve is made in sizes from ½ through 1¼ in. and may be used for services up to 150 psi and 400 F temperature.

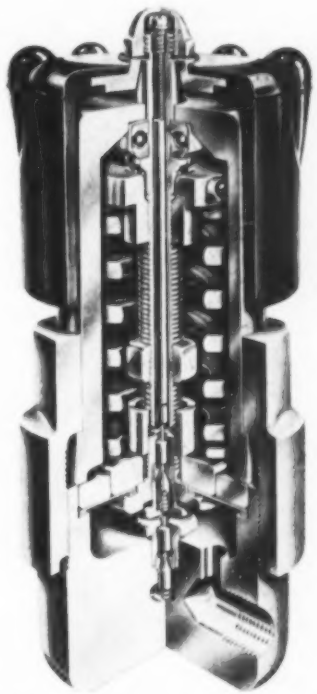
Constant Pressure Pilot Loader

Manual remote loading of a diaphragm or dome topworks requires a valve, which will admit and relieve pressure. An example of this follows: increase of pressure on the diaphragm of a diaphragm motor valve will move the valve in one direction, and pressure must be decreased for the opposite movement. The valve in Fig. 25 represents one manner of accomplishing this. Depressing the spring by rotating the control knob will force the inlet valve from its seat until the resulting pressure on the diaphragm closes it. Rotation of the control knob in order to reduce spring tension, opens the relief valve. In a static condition, an increase in pressure within the controlled system, (which might be caused by expansion due to temperature) will allow movement of the diaphragm to open the relief valve.

Another valve for this service, Fig. 26, obtains minimum droop with operating changes by isolating the diaphragm from the flow chamber to the valve. Pressure on the diaphragm is caused by flow through an aspirator tube. With this system, diaphragm pressure is abnormally low on pressure rise causing faster valve opening. The diaphragm pressure is abnormally low on pressure decrease causing faster closing.

Control Valves for Small Flows

Necessity for control valves of very low capacity has brought about a variety of plug designs under as many trade names. These valves are needed for pilot plant work, as well as for

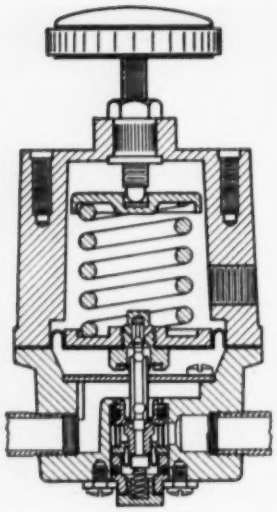


25 Manual loading of diaphragm has valve to admit and relieve pressure

services such as injection of inhibitors, blending, or pump control in full scale plants.

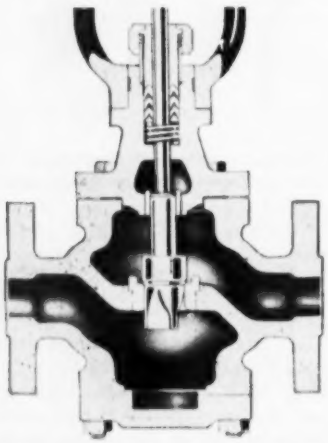
The single seated valve is most adaptable to this service with the plug seating down on the seat. One approach to low capacity is the needle valve or percentage plug when placed in suitable bodies, Fig. 27.

Constructional lower limit for this



26 Minimum pressure droop is obtained by isolating diaphragm from flow

27 Construction details of miniature valve that is only six inches high



28 These miniature valves are developed to have one thousandth gpm flow

valve is about ¼ in. with a C_v of about 0.60. One company specializes in miniature diaphragm control valves of high quality. Some of these valves are as small as 6 in. high with a body of ⅛ in. C_v factors as low as 0.001, or a water flow of one thousandth gpm in full open position with 1 psi pressure drop, may be obtained by machining a flute or groove in a piston, Fig. 28. Fig. 29 shows another design of fluted plug and its seat. These may be as small as ⅛ in. in diameter. Small seats and plugs are particularly susceptible to erosion so they are made of hardened steels. Very often they are stellited, or they are even constructed of stellite.

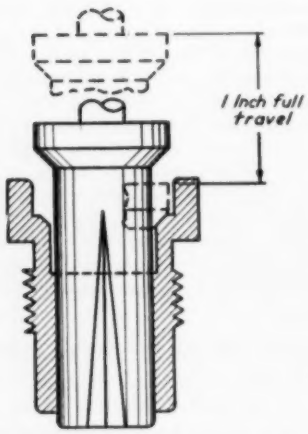
Capacity factors as low as 0.0001 have been obtained by the use of a valve that consists of an angle body with a needle, Fig. 30. The needle is positioned by rotating the stem. Movement is obtained through a threaded piece, attached to the stem, which works in a female stationary-threaded member. A 60 per cent rotation is obtained by using a pneumatic piston with spring return. The valve may be obtained with maximum travel as short as 0.0052 in. This requires very accurate movement. A positioner is used that senses valve travel by its connection to the piston shaft. The valve positioner allows a variation of piston loading pressures and valve stem rotation in relation to a standard controller output.

Reduced Trim

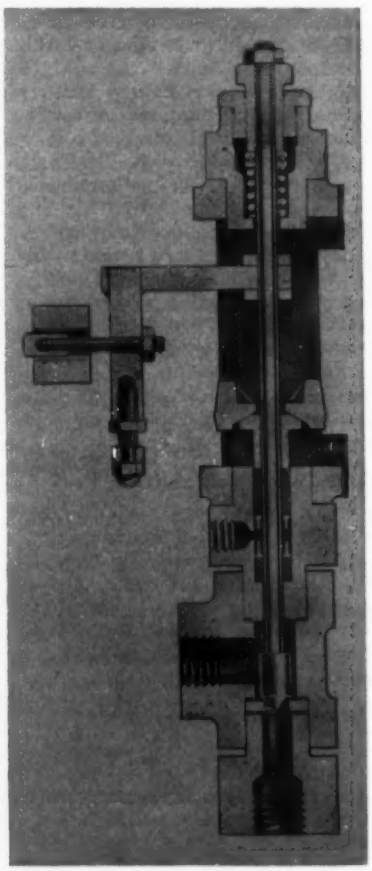
Reduced trim, or the use of smaller valve and seat than would be normally installed in a body, is considered for correction of various conditions. Some of these conditions are as follows:

a) increase relative size of body to decrease noise,
b) adequately handle increased volume due to flashing,
c) provide for increasing volume for future expansion,
d) improve control of oversize valve without change of body,
e) take advantage of strength of the parts of a larger valve,
f) economy of line sized valve, as compared to fittings, and
g) standardization of body sizes in a plant.

Although reduced trim is one way to approach each one of these conditions, it should not be employed without close scrutiny of the operating conditions, which seem to warrant this method. Analysis of the condition may show that a different valve design would be better, or if a question of capacity that the valve selected will handle the range adequately. Radical decreases in inner valve diameters should not be attempted. The affect of varying some dimensions, while others may not be varied due to the body size, may nullify the advantages of the reduced trim. Decrease of more than approximately one pipe size is considered inadvisable.

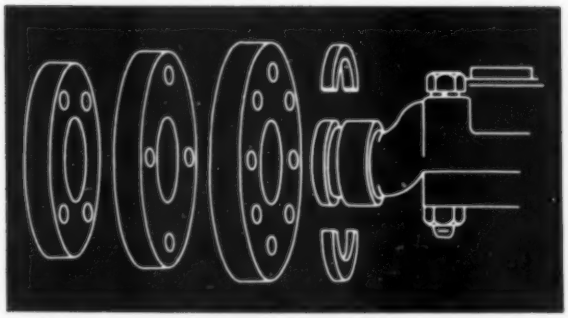


29 Piston, in these miniature valves, is fluted or grooved and has 0.125 dia



30 Needle is positioned by rotating stem. Capacity factors are 0.0001

Mechanical Features of the Valve Body



31 Manufacturers have standardized on dimensions. Here is a method of adapting different sized flanges to one body

TABLE 3—STANDARDIZED FACE TO FACE DIMENSIONS FOR CONTROL VALVES

Size	125# Iron 150# Steel	250# Iron 300# Steel	400# Steel
½	—	7½	8
¾	—	7½	8½
1	7¼	7½	8½
1½	8½	9¼	9½
2	10	10½	11½
2½	10½	11½	12¼
3	11½	12½	13¼
4	13½	14¼	15½
6	17½	18½	20
8	21½	22½	24

Mechanical features of valve bodies are discussed in this section but are not analyzed with respect to the various makes of valves for comparison. Features are mentioned so that the engineer may be aware of what is available and may select whatever suits his job. In many cases, the design of a special or unique valve precludes its comparison with regard to the detail discussed, so it is not specifically mentioned as an exception.

End Connections

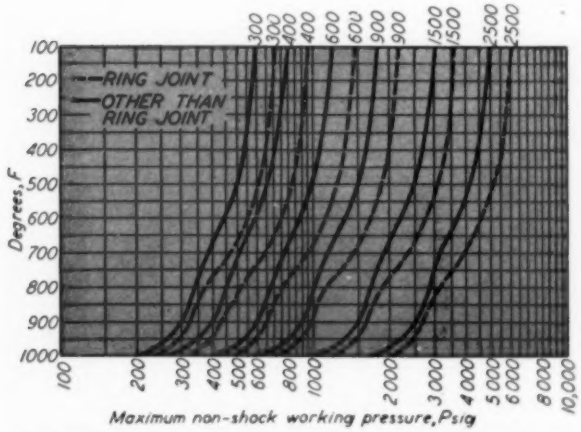
Selection of the end connections will follow closely the piping standards for the installation. End to end dimensions of flanged valves have been standardized by most manufacturers to be the same as line valves of the same pressure rating. These dimensions are shown in the Table 3. One company has designed a flange assembly with a split retainer ring to facilitate the changing of flanges. As the body is designed for 60 ASA rating, the 15, 30 or 60 series flange may be used with the same body. The assembly and the manner of holding the split ring are shown in Fig. 31. Many smaller regulators are furnished with union connections. Usage of weld end valves is becoming more prevalent, particularly in high pressure gas metering stations. In this case, the valves and swaged nipples form a spool piece.

Screwed end valves are used up to and including 2 in. unless unusual temperature or pressure conditions require flanges. Ring joint and tongue and groove flanges are installed only on elevated temperatures and pressures.

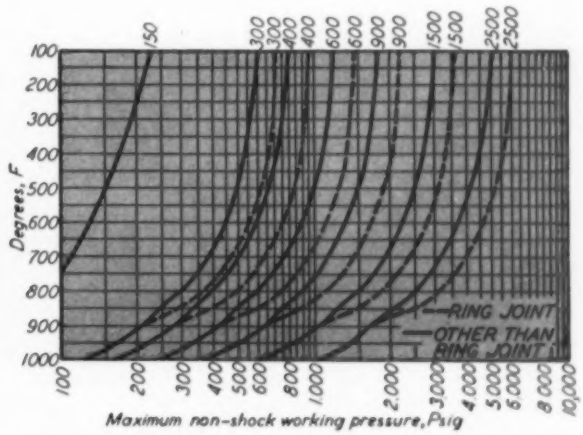
Body Design

Design of the body of each valve for the pressure and for the service for which it is to be used is the responsibility of the manufacturer. Certain designs have allowed the valve to be much lighter than others, a quality that should be popular with field men. The porting of the discharge side of the plug and seat should be large enough and so shaped that it does not contribute to the pressure drop of the valve. For best control, the pressure drop should be across the variable restriction of the valve. It is to be lamented that valves are no longer being constructed with an expanded discharge, including a larger flange, as is done with relief valves. Certain valves do show evidence of design toward getting rid of the flow as fast as it passes through the orifice. The venturi of the angle valve assists in accomplishing this.

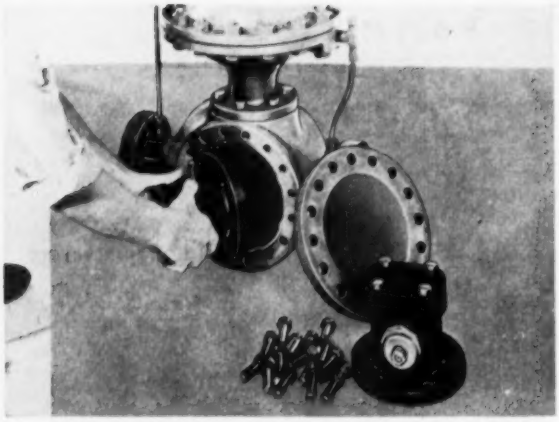
Selection of the metal used in the body and trim must be made upon the basis of the specifications for the piping at the point of installation of the valve. Temperature-pressure ratings



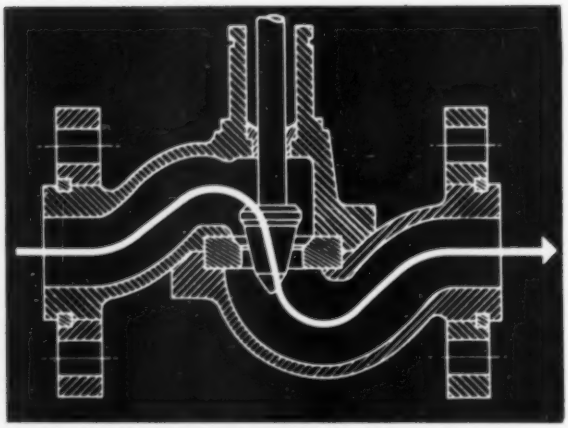
32 Selection of metals employed in the valve body and trim must be made upon piping specifications. In Fig. 32 the



temperature-pressure ratings are for carbon steel valves. Fig. 33 ratings are for carbon molybdenum and alloy steels



34 Access to the plug and seat is essential, and this is accomplished with removable top, bottom, or side flanges



35 The single seated valve, indicated above, is very easily dismantled for replacement of both the seat and plug

are shown on the curves of Fig. 32 and 33.

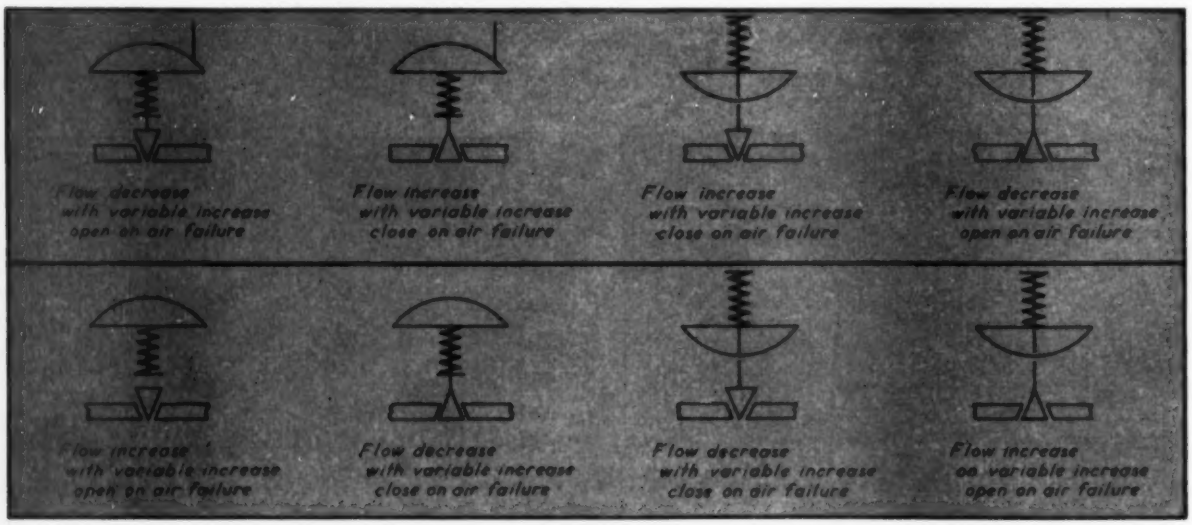
There is a strong trend, in plants, toward the use of steel bodies for hydrocarbons and steam distribution for all temperatures and pressures. Stainless steel trim is being used in many cases to combat erosion rather than chemical action. The cost of stainless steel bodies requires careful consideration of their necessity. Most water service calls for bronze or iron bodies and brass trim. Particularly difficult chemical services will require special metals, plastics, or ceramic bodies or rubber, plastic, or ceramic linings.

Although most valves have been developed to minimize erosion, there are many cases where this condition will develop unexpectedly. The valve selected will develop thin spots. Every effort should be made to foresee possible excessive erosion. This can occur when vapors contain globules of water, when supposedly clean natural gas has picked up sand from the pipeline, or when contaminated condensate creates an acid condition that contributes to erosion as well as corrosion. Stelliting or some other hard surfacing may be necessary unless care is exercised to select a *special* valve for the service.

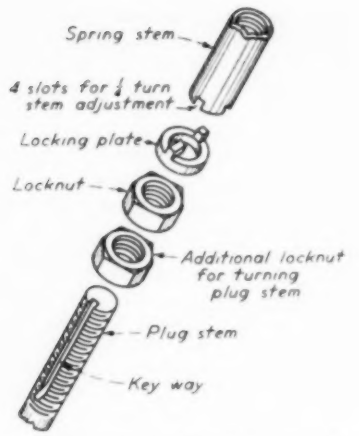
Easy access to the seat and plug is essential. Most valves have replaceable seats. This is a desirable condition, but it requires working inside of the valve for replacement. This is accomplished with a removable top and bottom flange or side flange, Fig. 34. The single seated valve in Fig. 35 is very easily dismantled for replacement of the seat or for removal of the plug.

Unless a valve is designed for one service alone, it should be readily reversible. In process instrumentation, it is somewhat difficult to analyze the application to determine whether a valve should be normally closed, that is to close on air failure or whether it should be normally open. The sketches in Fig. 36 and 37 show the various possibilities when the valve is used with a controller.

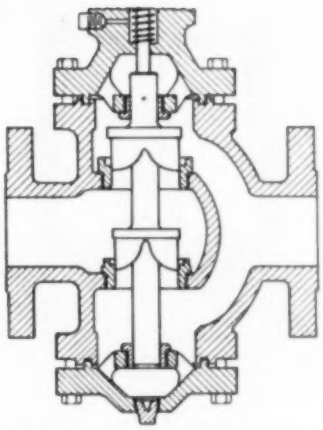
Proper seating of the plug on the seat requires a positive and unchanging relation between the plug and the seat and requires proper guiding. Wing guides are used for quick-opening valves, and the skirt of the various forms of V ported plugs is used as the guide. The close tolerances, which are necessary for guiding these valves properly, cause them to stick when there are wide temperature changes, heavy fluids, foreign matter, or even when they become cocked in relation


Flow decrease with variable increase open on air failure
Flow increase with variable increase close on air failure
Flow increase with variable increase close on air failure
Flow decrease with variable increase open on air failure
Flow increase with variable increase open on air failure
Flow decrease with variable increase close on air failure
Flow decrease with variable increase close on air failure
Flow increase with variable increase open on air failure

36 & 37 Unless a valve is designed for one service alone the valve and diaphragm should be readily reversible. Both drawings show various possibilities of valve action when controller output pressure increases or decreases



38 Strong connections between plug stem and spring are very important



39 Guides tend to keep the upper and lower portions of the body free

40 Valve cage assembly includes three components: plug, seat, and guide

to the seat. To eliminate cocking, some form of ball and socket has been used to allow the plug to position itself. Ultimate ability to seat is accomplished by a ball plug, which is lifted off the seat by the stem, Fig. 13. The desire for full use of the flow characteristic of a control valve has forwarded a trend toward top and bottom guiding with solid connection between plug and stem.

Plug Movement

Difficulty with dropping the plug off the stem, in the past, has emphasized the importance of strong connection between the plug and stem. High rotational forces are set up, (particularly with all types of V port valves) that cause lock nuts to come loose or stems to break. A well designed plug-stem connection is shown in Fig. 38. In the conventional control valve body, the bottom guide is part of the bottom flange, while the top guide is in the top flange or bonnet. For establishing proper alignment of guides and seats, the flanges must have shoulders to fit a recess in the body.

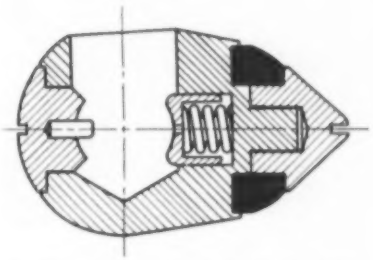
Guides, Fig. 39, tend to keep the upper and lower portions of the body free from accumulations. A valve cage, Fig. 40, includes the plugs, seats, and guide. Proper seating of the plugs on the seats is obtained by raising or lowering the bottom seat by means of shims. As mentioned before, the angle and S valves use stems of essentially the plug diameter and long guides. Length of the guides may be as much as five times the plug diameter. Guiding of soft-seated valves, and many of the unique designs, is not too important, yet consideration of this item is necessary for good operation of most valves. Adequate guides have been furnished for soft seats on low pressures.

Metal-to-metal plugs and seats may be accepted for services where complete shut-off or lock-up is not necessary. Double seated valves have the inherent difficulty of maintaining uniform seating surfaces and will begin to leak after being in service. All manufacturers of valves do exceptional work in furnishing tight valves, but they cannot remain tight after continual use. Selection of hard metals will increase the period of low leakage. However, due consideration must be given to the process in order to decide whether a probable 6 per cent leakage in closed position will be detrimental or even unsafe. The single-seated valve will give much better shut-off over a much longer period. Use of the single-seated valve has been confined to small sizes and low pressure drops due to excessive unbalanced forces. Now, more consideration is being given to their use in employing piston motors and springless diaphragm motors in order to position the valve.

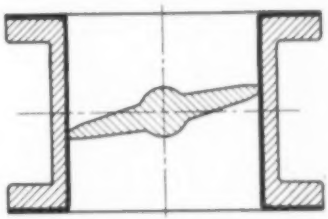
Necessity for complete lock-up indicates a soft seating surface. One method of obtaining this is the conventional rubber, leather, or composition disc to contact a metal seat. Fig. 41 shows the soft surface as part of a streamlined plug. Valves using a rubber sleeve or diaphragm for closure will give tight shut-off. The tight closure is obtained in the butterfly valve by using a rubber insert, Fig. 42.

Representative of a large group of regulators particularly for water service is indicated in Fig. 43. In this type of body the flow is directed down upon the disc, which is carried on a cage that moves with the diaphragm. The disc or seal shell is guided by a spring. The design pictured includes a strainer, which is common for water regulators.

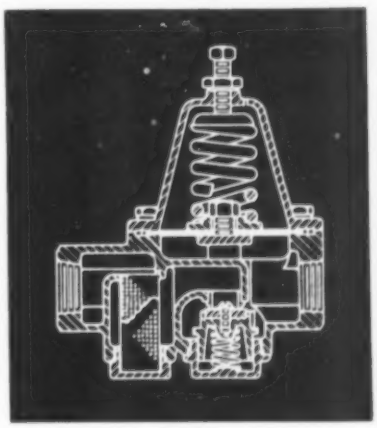
Many valve applications require



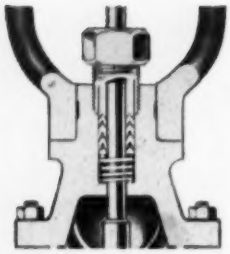
41 Plugs can be streamlined, as above, and surfaces can be soft materials



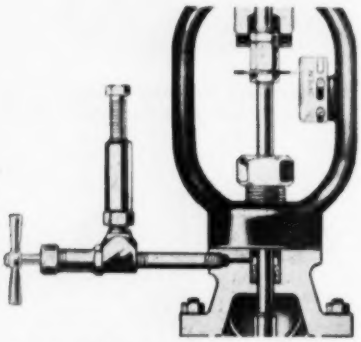
42 Tight closures are obtained in the butterfly valve with a rubber insert



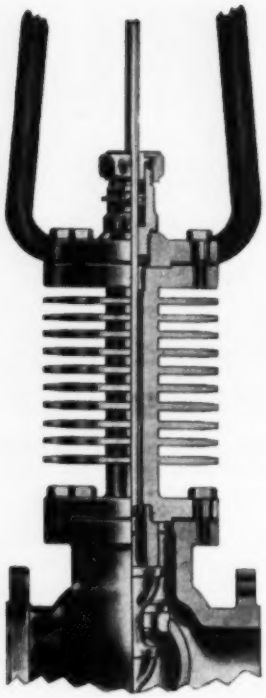
43 Flow is directed down onto the disc, and the cage moves the diaphragm



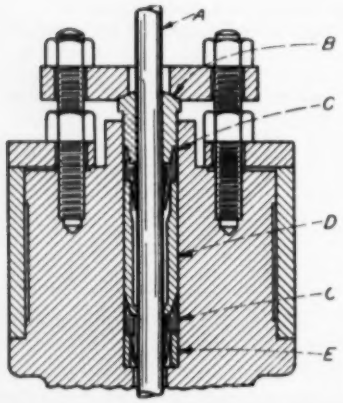
44 Chevron rings are a component part of this ring type packing gland



45 Isolating valves are recommended at 100 psi and 250 F temperature



46 Cooling fins are needed when fluid is over 450 F to prevent sticking



47 Plastic seal is claimed to operate successfully at 27,000 psi pressure

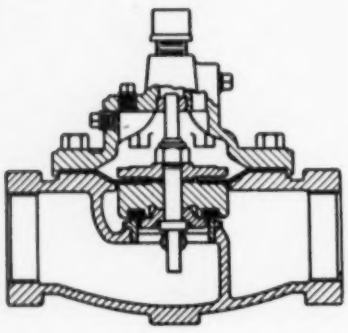
some manner of regulating minimum or maximum flow. A set screw in the bottom flange becomes a minimum flow stop for a pressure-to-close valve, and a maximum setting for a pressure-to-open valve. This stop may be applied to the diaphragm movement of a diaphragm operated valve.

Inasmuch as the operating device, whether a diaphragm or electric motor, must, in most valves, pass through a yoke to the body of the valve, some type of packing gland is necessary. This unpretentious portion of the valve can cause the success or failure of the control. A ring type packing gland is shown in Fig. 44 in which a chamber contains chevron rings. High pressure packing is accomplished by using a gland and a bolted or screwed gland follower. Grease is introduced to a lantern ring between the packing rings and is injected by a screwed injector. For services above 100 psi, temperatures above 250 F, or corrosive liquids, the use of the isolating valve is recommended, Fig. 45. A cooling fin section, Fig. 46, is necessary for elevated temperatures over 450 F that would cause the packing to stick. An extension is also used for very low temperatures. The selection of the proper grease is important. The recommendations of the manufacturer may be used with confidence.

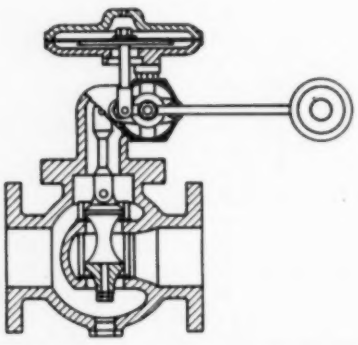
A patented plastic seal is shown in Fig. 47. The assembly consists of a super-finished plug stem, gland follower, plastic seat, gland, plastic seal, and lower gland. The seal is claimed to be operative to as high as 27,000 psi. It is completely resistant to chemicals, has minimum friction, is leak proof, and requires only initial adjustment.

Utilization of Teflon (tetrafluorethylene resin plastic) for packing, as well as other uses, has become very prevalent. The very low coefficient of friction, as well as its inertness to chemicals, ease of forming, and high tensile strength contribute to its popularity for rings of various shapes. It is shredded between container rings and used in combination with asbestos, graphite, and other materials. The engineer should take advantage of this material whenever applicable but should confer with the manufacturer to determine the limits of its use in his valve. Back purge through a labyrinth ring is sometimes necessary to protect the packing from highly corrosive liquids.

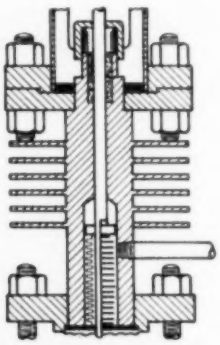
Various types of valves, Fig. 48, use a diaphragm seal rather than diaphragm a packing gland seal. A style of regulator known as a balanced diaphragm valve requires no seals, as the line pressure is exerted on the operat-



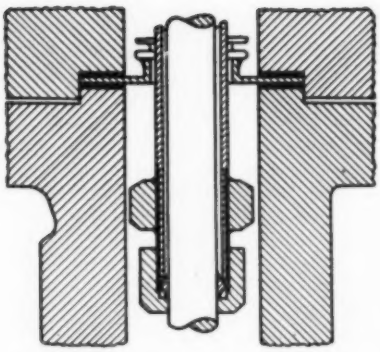
48 Diaphragm seals are employed rather than a packing gland



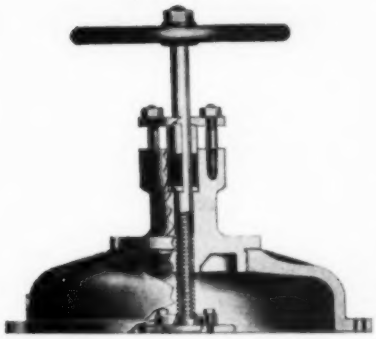
49 Operator stem is geared to valve and rotated through the top-works



50 Top of bellows is welded to the stem while bottom is welded to the seal



51 Guide is sealed to the stem with a compression ferrule and lock nut



52 Threaded hand wheel is simplest method to close air-to-close valves

ing diaphragm. These valves are discussed further on in this article.

To obtain the low friction effect of a rotating stem, rather than the up and down piston, the approach shown in Fig. 49 is employed. A stem is rotated by any of the standard topworks. This stem is geared to the valve stem, so that rotation caused by the topworks will open or close the valve.

Development of the construction of steel bellows has made possible their adaptation to a packless valve. Methods of accomplishing this are shown in Fig. 50 and 51. Fig. 50 illustrates the top of the bellows welded to the stem. The bottom of the bellows is welded to a flange, which seals the line fluid within the body. In Fig. 51, a guide is sealed to the stem with a compression ferrule and locknut. With the bottom of the liner guide welded to the bellows and the top of the bellows welded to a flange the line fluid is held within the body. Packless sealing is accomplished by welding the bottom of the bellows to an internal guide, which in turn is welded to the stem, and the top is welded to an external chamber. The chamber is seated on sealing packing at the bottom. In this design, the bellows tube collar acts as a safety travel stop. A hexagonal guide through a bushing eliminates bellows rotation.

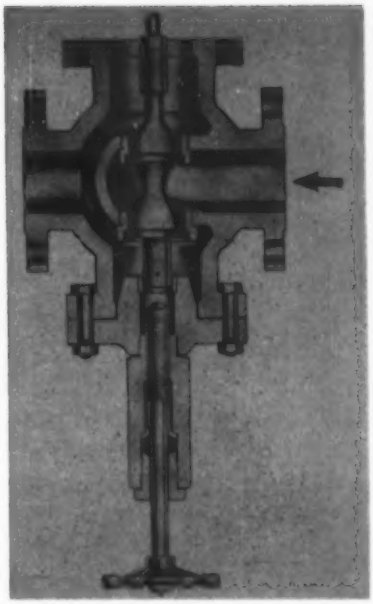
Necessity for manual operation of control valves, when dealing with abnormal or emergency conditions, has brought about various approaches. The simplest way to close an *air to close* valve, is to install a threaded hand wheel in the diaphragm case, Fig. 52. This approach is not wholly satisfactory as an emergency operator, since the spring is required for opening. Spring troubles, however, are so rare that this design is used widely. The hand wheel may be installed in the bottom flange of the body, Fig. 53, when this approach is indicated. In either case, the hand wheel stem must be retracted for normal use of the value, unless it is desired to limit the travel of the plug.

Butterfly valves may be operated with a manual wheel by a de-clutching system that releases the diaphragm operator. This same approach is used on plug cocks having actuators for adaption to automatic operation.

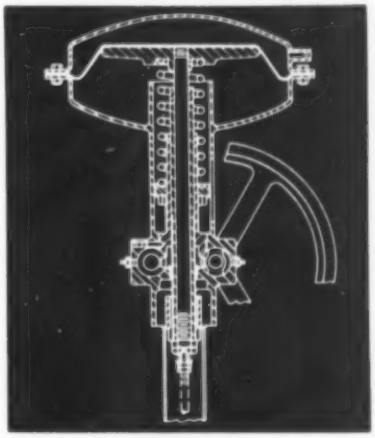
Hand wheel operation has been applied to the stem so that the valve may be operated without the assistance of the spring. These manual operators will open or close the valve in opposition to the force on the diaphragm or against the spring action. For this reason, they may be used in case of faulty spring operation or in case of ruptured diaphragm. Reference to Fig. 54 shows that an externally threaded sleeve around the stem will move the stem downward by pushing upward on the locknuts. This sleeve will raise the stem by pushing upward on the diaphragm plate. Movement of this stem is accomplished by a nut shown in the central housing. This nut cannot move up or down, and when rotated by the worm gear on the hand wheel shaft, it raises or lowers the sleeve. The jacking screw is guided so that it does not rotate but only moves vertically.

In another form of hand wheel operator, the rotation of the hand wheel raises or lowers two sets of fingers, Fig. 55. This action positions a crosshead, which will lift the stem when it contacts the upper nut of an adapter and pushes the stem down when operated in the opposite direction.

Hand wheel operation is accomplished by a design, which allows the actuating lever arm, operated by the hand wheel, to be locked to the spool follower, which moves the stem by a controlling pin. Movement of the stem may be accomplished by lining up the actuating lever arm with the slot of the spool follower so that the controlling pin locks the two together. This may occur in any position of the stem, and rotation of the hand wheel moves the stem up or down from this point.



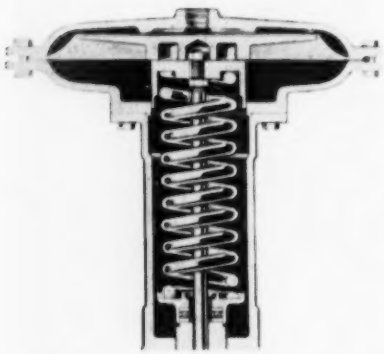
53 Threaded handwell in bottom flange is manual operator for air-to-open



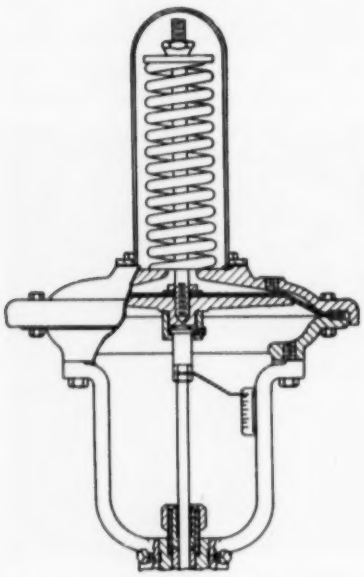
54 Externally threaded sleeve can position the stem when wheel is rotated

55 Two sets of fingers are raised or lowered to position a crosshead

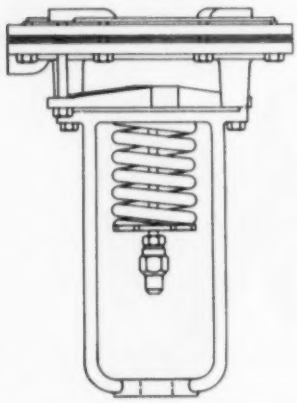
Actuator Design



56 *Pressure on diaphragm positions the valve against adjustment of spring*



57 *Bottom of spring is stationary, and spring tension is made at the top*



58 *Valve stem raises when diaphragm pressure is increased by a spring*

In the previous section, the various body designs used in control valves and regulators have been described. Only by restricting the flow through this valve body can pressure, flow, level, or any of the variables be controlled. It is the purpose of this section to describe the actuating devices used to operate these bodies to cause a variable restriction. Referring to Fig. 22 as an example, establishing a definite line of demarcation between the body and the actuator is sometimes difficult. In most cases, however, we have discussed the body of the valve up to and including the stem packing. The actuating mechanism is external to this. The discussion in this section will include diaphragm topworks, piston operators, and air and electric motors.

In the introduction to the first section, Table 1 lists the physical characteristics of an ideal valve body. The ideal valve body is non-existent, so the actuator must operate to overcome the actual conditions that do exist in the valve body. These conditions are as follows: hysteresis in movement of parts, weight of moving parts, and unbalanced forces across the valve seat. The actuator must also have sufficient power and stability to overcome undesirable inertia affects in large valves. It should also have speed of response so as to satisfy installation conditions.

A typical spring loaded diaphragm topworks is shown in Fig. 56. In this design, the spring rests on a plate, which may be raised or lowered with an adjusting screw. The spring exerts pressure on the diaphragm by its contact with the diaphragm plate. The valve stem is connected with the diaphragm plate. The same action of downward stem movement is accomplished with the design shown in Fig. 57. In this design, the bottom of the spring is stationary, and the adjustment of spring compression is made at the top. Adjustment of the spring is accomplished after shutting off the pressure to the diaphragm and after removing the spring housing. No stem guides are used with this topworks, because it is claimed that alignment is obtained by the spring suspension and the flexible-stem connection.

Certain of the valve actions require a topworks that will raise the valve stem when the diaphragm pressure is increased. This may be done with the spring above the diaphragm or below it as shown in Fig. 58. In both types, installing a packing gland to avoid leakage around valve stem is necessary.

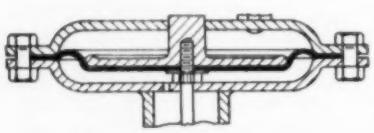
Considerable study has gone into the design of the diaphragm case and diaphragm. The use of molded diaphragms, Fig. 59, has contributed to better alignment of the stem and high-lift valves. Although the high lift is not necessary for quick opening regulators, it is essential in most control valves in order to take advantage of entire flow characteristic range.

Wider use of steel bodies has caused a trend toward the use of steel topworks. For valves smaller than 3 in., the steel topworks is much lighter than cast iron. Above the 3 in. size, there is little difference in the weights. Use of the steel topworks affords additional protection against fire and fracture.

Most diaphragm cases are fastened with the bolts passing through the diaphragm. One style is distinctive because it used a two-bolt retainer ring, Fig. 60. Another feature of this design is the selfsealing action, which is obtained by the molded lip around the diaphragm.

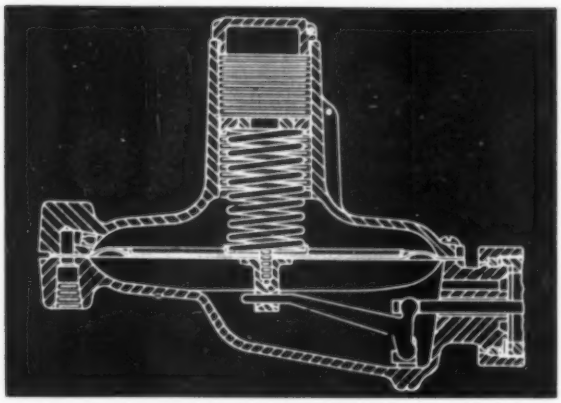
Illustrations throughout the article will show various methods by which the diaphragm actuator, as well as other methods to be discussed, may be used to operate various types of valves, such as plug cock and butterfly valves.

Probably the actuator illustrated in Fig. 61 is the most prevalent of any type, because each domestic consumer receiving gas from an intermediate or high pressure distribution system must have a regulator, which incorporates one. The controlled low pressure is either open to the diaphragm case, or it is brought in through a port. This eliminates the use of bearings, which would be detrimental to accurate control with the low pressures and volumes involved. Various toggle arrangements

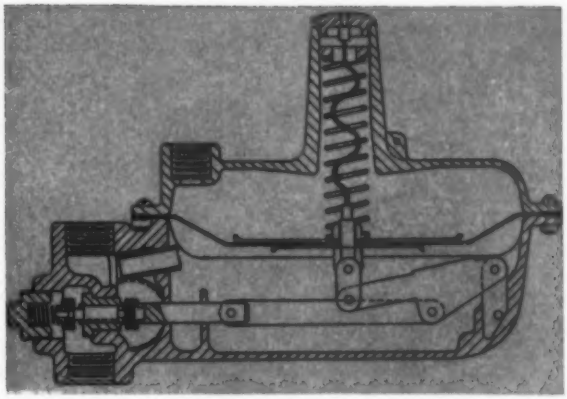


59 *Molded diaphragms have contributed to better stem and valve alignment*

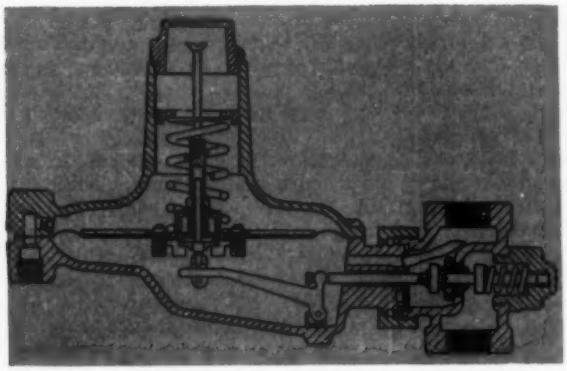
60 *Most diaphragm cases are fastened with bolts passing through retainer*



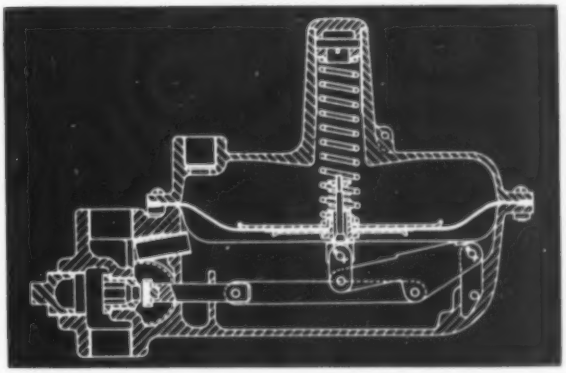
61 *Various toggle arrangements are used to obtain straight line motion of stem to increase power of the diaphragm*



62 *This regulator was designed for shut-off on over pressure, by having abnormal movement of stem cover inlet seat*



63 *Excessive downstream pressure separates diaphragm from toggle arm to close valve, low pressure closes valve*

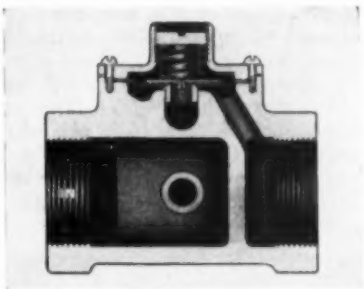


64 *These regulators are furnished with internal relief valves that vent abnormal pressure to the atmosphere*

are used to obtain straight line motion of the stem and to increase the power of the diaphragm.

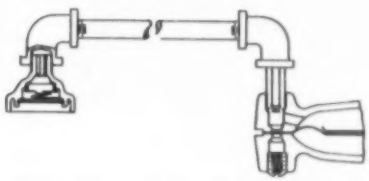
Due to the necessity for absolute reliability where there is infrequent maintenance inspection, these regulators have been designed for various maloperations. Fig. 62 shows the regulator designed for shut-off on over pressure. Abnormal movement of the stem will cover a seat at the inlet. In this type of regulator this closed condition would exist as long as the reduced pressure remained excessively high. A cord has been provided to open the valve manually. This allows the pressure to equalize so that the regulator may go into service again. In other designs, a rod is furnished to accomplish this function.

Magnetic linkage between the diaphragm and the toggle arm that operates the valve allows for additional safety features, Fig. 63. In this design, excessive downstream pressure will separate the diaphragm from the toggle arm so that the valve remains closed. Abnormally low pressure will close the valve, which will remain closed due to the spring and supply pressure, until opened with a rod provided for that purpose.

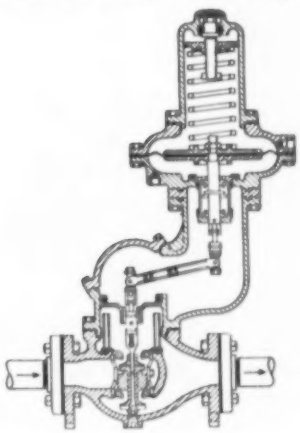


65 *This relief valve handles the full capacity of the reducing orifice*

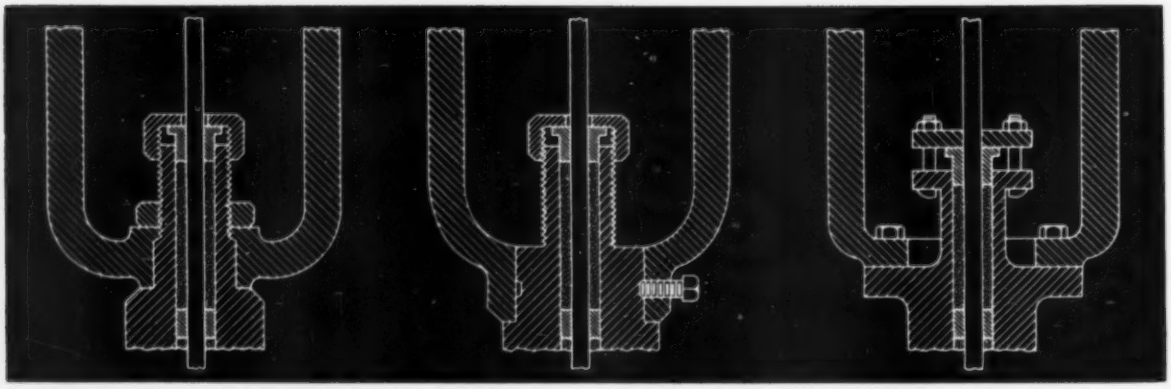
These regulators are furnished with internal relief valves, one of which is shown in Fig. 64. Another ingenious design, Fig. 65, places the relief valve so that it will handle the full capacity of the reducing orifice rather than handle a restricted volume that may pass through a static pressure tube. Due to the low set pressure of these regulators, the spring side of the diaphragm must be kept at atmospheric pressure. Leakage through the dia-



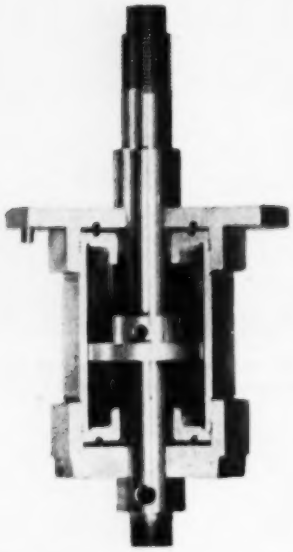
66 *Weather proof and bug proof cap is designed as a pulsation dampener*



67 *Actuator is offset from body to make possible greater power availability*



68, 69, & 70 Various features have been designed into the diaphragm topworks to facilitate greater ease in adjusting the spring tension. Details in these three illustrations indicate the typical yoke constructon employed



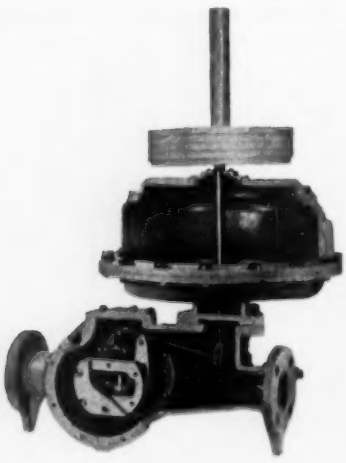
71 Stabilizer piston in oil dash pot is attached to cylinder valve stem

phragm must not be allowed to be dissipated into the surrounding area. This usually requires a vent from the diaphragm case. Fig. 66 shows a weather proof and bug proof cap, which is also designed as a pulsation dampener. These topworks are furnished with a union connection to the valve body so that the relationship of the body and topworks may be oriented to fit the installation. The plug and seat may be reversed to obtain a back pressure regulator or relief valve. An increase in pressure on the diaphragm opens rather than throttling the valve.

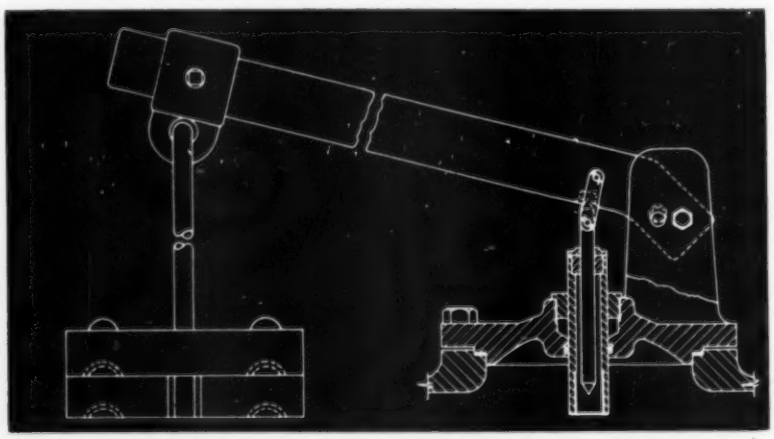
Regulators are available with the actuator offset from the body, Fig. 67. This design makes possible increasing the power available from the diaphragm by changing the fulcrum position of the rocker arm. The design gives easy access to the valve cage in a different way than Fig. 34. This is accomplished by cover plate removal.

Stem travel indicators are desirable so as to determine the position of the plug. One type is evident on the topworks pictures. In some cases valve position is shown by attaching a small rod to the diaphragm plate and allowing it to protrude through a hole, either in the top or bottom of the diaphragm case. Construction features of some valves do not permit showing amount of opening by simple means.

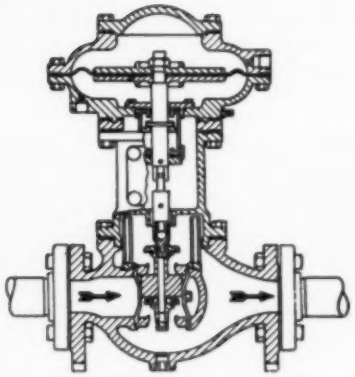
Various features have been incorporated into the design of diaphragm topworks. Many manufacturers use ball bearing base plates in contact with the spring to give greater ease in adjustment. The bolt circle attaching the yoke to the diaphragm case is usually the same for various sizes of case in order to facilitate change. Yokes have been designed to increase the clearance for access to the spring adjustment nut. Typical yoke constructions are shown in Fig. 68, 69, 70—a) slip construction secured by nut, b) slip construction with set screw, and c) bolted. Some valve stems are constructed to accommodate travel stops.



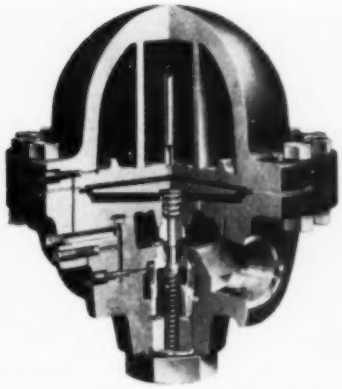
72 Weight loading can be substituted for spring loading of off-set valve



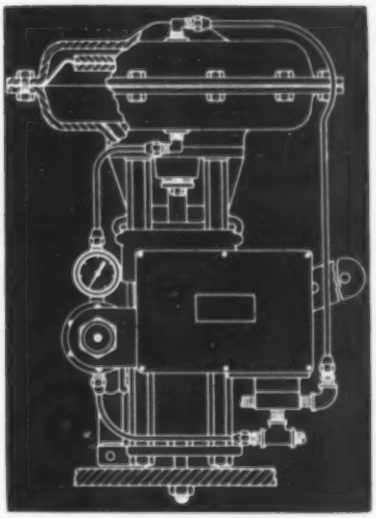
73 Method of applying a force of a fixed weight to the stem of a valve offers a wide flexibility due to the ease of changing the length of the fulcrum arm



74 Predetermined pressure takes place of weight or spring on diaphragm



75 Predetermined pressure is locked into the dome with a needle valve



76 Regulator becomes springless motor with 5 to 30 psi air replacing load

which collide with the packing nut when moving down or with the diaphragm case when moving up. A stabilizer unit is shown in Fig. 71. This consists of a piston attached to the valve stem that moves within a cylinder, which is filled with oil. Selection of oil depends upon the amount of dampening desired. The stabilizer may be installed on a service, which is pulsating, hunting, or surging.

Weight loading may be substituted for spring loading, and a version of weight loading an off-set valve is pictured in Fig. 72. Method of applying the force of weights to the stem offers wide flexibility due to the ease of changing weight arm and, when necessary, the diaphragm case. The affect of loading may be reversed by changing the falcrum location, Fig. 73.

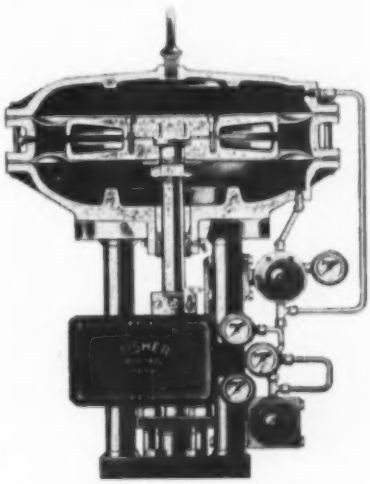
By using a diaphragm case, Fig. 74, the controlled static pressure of a line can be piped to one side of the diaphragm and a predetermined pressure exerted on the opposite side. In this manner, the predetermined pressure takes the place of the weights or a spring. In one make of regulator, Fig. 75, this predetermined pressure, which becomes the set pressure of the regulator, was locked into the dome with a needle valve. The more common way is to apply this pressure through a small pilot valve of the type shown in Fig. 25. The topworks in Fig. 74 uses the pilot on the inlet to the diaphragm case with a restricted bleed from the case. Many systems may be devised using the balanced diaphragm valve and pilot regulators.

This balanced diaphragm regulator becomes a springless diaphragm motor valve, Fig. 76, when a predetermined constant pressure of from 5 to 30 psi is held on one side of the diaphragm, and the output of a valve positioner is applied to the other side as dictated by a pneumatic controller. With a 15 psi loading on underside of the diaphragm and 30 psi available through the valve positioner, a 15 psi differential force is available for movement in either direction. This force applied to the area of the diaphragm makes a tremendous total force available for correctly positioning the valve. Predominant thrust in one way or the other can be developed by changing the loading under the diaphragm.

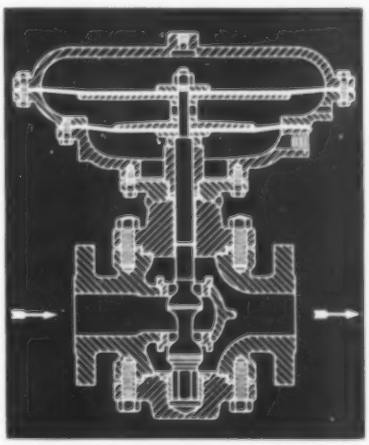
Another approach to the springless diaphragm motor is accomplished with equipment shown in Fig. 77. The diaphragm case contains two equal diaphragms, both of which are connected to the valve stem. Accessories include a filter-regulator set, valve positioner, and reversing relay. Output pressure of a controller dictates the output of the positioner. This pressure goes to the top of the top diaphragm and between the two diaphragms of the relay. The top diaphragm of the relay has twice the area of the lower one. Thus, upon an increase in loading, pressure will bleed the lower diaphragm. The unbalance between the main diaphragms will continue to increase until the valve stem reaches its correct position and re-positions the valve positioner to establish the balance. The sum of the two pressures on the diaphragms always remains at the supply pressure, which is 30 psi.

Double diaphragms may be used in a pressure loaded valve. The valve illustrated in Fig. 78 will control at a pressure in excess of the loading pressure by the ratio of the areas of the diaphragms. The ratio may be reversed or may be one to one.

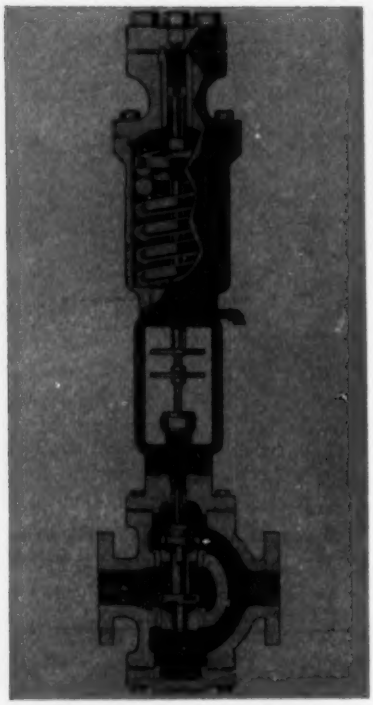
Certain valves, for example the rubber sleeve type in Fig. 22, are special types of pressure-loaded valves in which it is difficult to say that an actuator exists. Pressure must be introduced through the use of an external or built-in pilot.



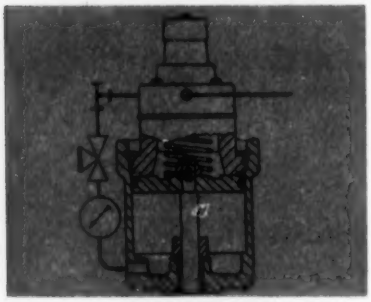
77 Springless motor action obtained with reversing relay and positioner



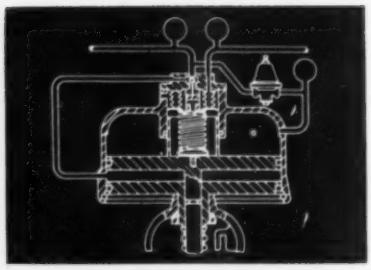
78 Ratio of diaphragm areas can vary range of a pressure loaded valve



79 Small piston in pump governor is adaptable for high pressure operation



81 Piston actuator is designed with an integrally mounted positioner unit



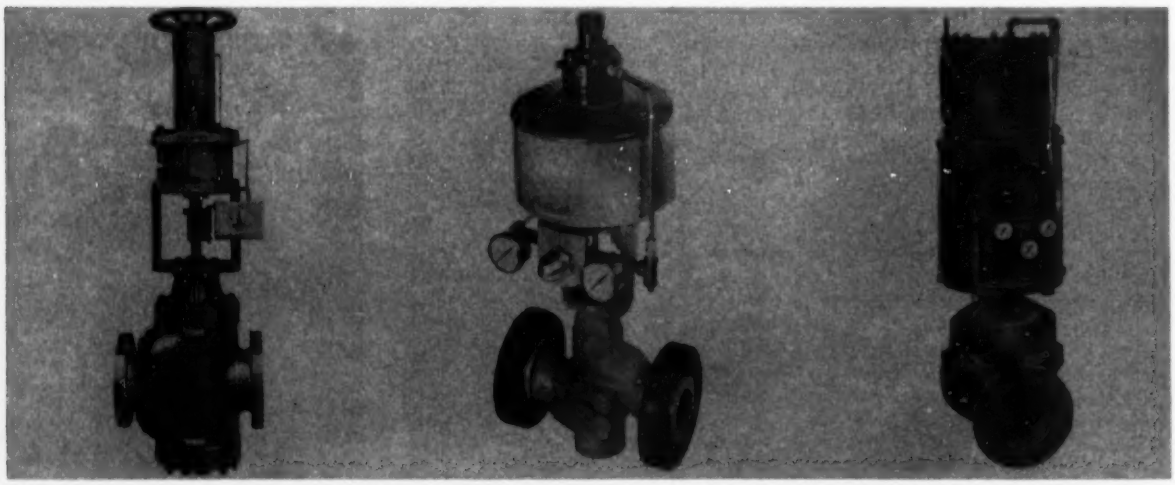
80 This piston operator can accurately position the stem at high pressures

In design of the balanced diaphragm valve, the fact that improper operation may subject the topworks to extreme forces must be recognized. These valves are used extensively on gas fired heaters. A slight leak, a partially opened bypass used for start-up, or a minimum flame orifice can very rapidly build up pressure when the burners are inadequately shut without shutting off the gas supply. Full line pressure will be exerted on the diaphragm, causing a total force of many tons. These forces require careful consideration of the plug stem, the diaphragm nut, and diaphragm buttons, as well as the design of the diaphragm case. The double diaphragm topworks does offer some protection from having the line pressure back into the controller when the diaphragms ruptures, because the space between the diaphragms may be safely vented to dissipate a portion of the gas.

Piston Actuation

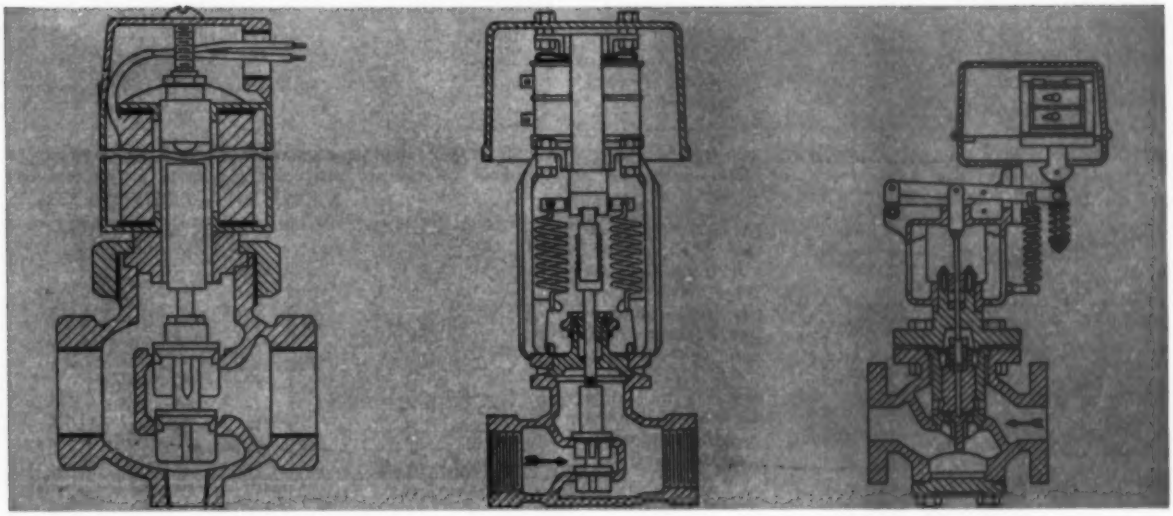
Usage of a piston in a cylinder is the commonest of power machines. This is one of the important ways to operate a valve. The disadvantage of the piston has been the necessity of limiting the size because of weight and friction, thereby requiring high pressures for operation. This discussion will point out how these disadvantages have been mastered. The pump governor, Fig. 79, is an example of a disadvantage becoming an advantage. A small piston is necessary due to the high pump discharge pressure, which is being controlled. This would not be possible with a diaphragm actuator. By using elevated pressures, the piston actuator can handle much greater valve positioning loads than is possible with the diaphragm actuators.

Pistons have long been used to operate all forms of valves. Until the last few years, they have been either spring-loaded like the pump governor or operated by four-way valves. Piston operators, operating on pressures up to 50 psi for Fig. 80 and 100 psi for Fig. 81, make possible the accurate moving and positioning of large valves and single-seated valves with high pressure differentials. These piston actuators differ in that Fig. 81 is loaded with a constant pressure above the piston, while Fig. 80 is loaded below. The development of piston loaders was made possible by the use of O-rings or block vee seal packing between the piston and the cylinder and very, very careful preparation of the inside surface of the piston. Pistons are moved by a pressure output of a controller that sets a valve positioner. Actuating pressure is fed to the piston by the positioner until valve movement is accomplished. The piston without any load will move as soon as the actuating pressure reaches the loading pressure. All additional supply pressure is available to overcome the friction forces and the pressure unbalance. These piston loaders may be adapted readily to stem or lever operated valves, Fig. 82, 83, and 84.



82, 83, & 84 In these three illustrations the actuating pressure is fed to the piston by the positioner until valve movement is accomplished. All supply pressure is available to overcome friction and the unbalanced pressure

Electrical Actuation



85, 86, & 87 Electrical actuated devices are being called upon to perform the same operations on valves as the pneumatic type. Solenoids can be operated either for on-off position or with multiple coils for intermediate points

Utilization of electrically actuated devices for positioning a valve is an extensive subject in itself. It must, however, be summarized in this section as the engineer should not neglect to consider any approach that may have advantages when dealing with a valve problem. The electrically actuated devices are topworks, just as are the pneumatically operated types.

Solenoid Valves

Solenoids are employed in many designs to operate a valve. Most of these uses are for on-off service, Fig. 85, 86, and 87, although multiple coil solenoid valves are furnished to give an intermediate point, as well as the on-off positions.

Solenoid operation does not adapt itself to large valves or high pressure drops. For these services, the solenoid operates a small pilot valve to allow line pressure to operate the main valve, which employs a diaphragm or piston. The solenoid may be adapted as a pilot, which admits pressure to the piston chamber of the line valve. A diaphragm motor valve, Fig. 88, contains a solenoid actuated pilot valve as an integral part of the topworks.

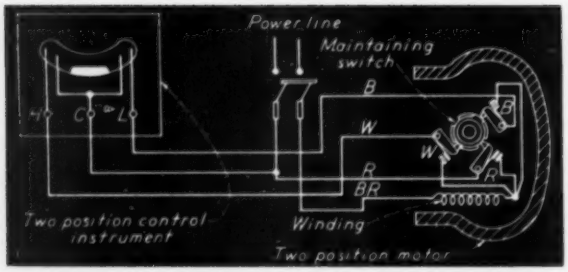
Electric Motor Operation

On-off operation of a sliding-stem valve may be obtained by using a unidirectional motor with a linkage, Fig. 89. A plug valve or butterfly may accomplish the same type of control when adapted to the motor with a connection, Fig. 90. The motor must be wired so that it will stop when the linkage has reached one extreme of its

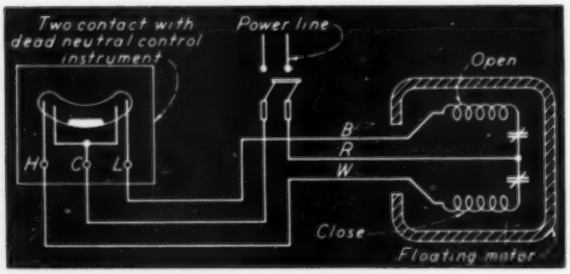
88 The solenoid, in this motor valve, operates as a pilot in the actuator

89 On-off operation may be obtained by unidirectional motor and linkage

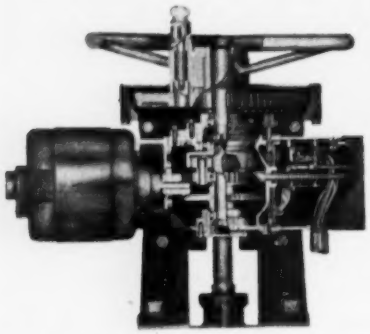
90 Control circuit stops motor when linkage has reached extreme travel



91 Closing of contacts in the mercury switch of the controller energizes the motor for on-off valve operation

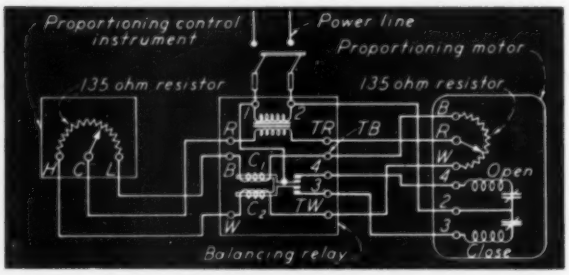


92 Floating control is obtained by employing a reversible motor to operate the valve slowly in either direction



93 Operator may be adjusted to apply any desired pressure upon the seat

94 Throttling action of electrical circuit positions the valve during its entire stroke. Operation follows principle of the Wheatstone bridge, with resistors and slide wire to position the reversible balancing electric motor



travel. Thus, the valve is placed in either open or closed position. This condition will exist until the flow, or lack of flow, through the valve affects the controlled variable enough to require the controller to cause a reverse operation of the valve. The motor will continue to rotate the linkage through another half cycle, when the motor will stop again. The operating cycle of the motor and controller may be accomplished as shown in Fig. 91.

Reference to the illustration shows that when the mercury of the controller switch causes contact between C and L, current passes through B to cause the motor to rotate. After the motor has rotated 30 deg, the finger contact R closes, and the current continues to feed through the motor winding. Under this condition, B circuit may be open and the mercury switch may be at an intermediate point, thus making no contacts. Contact R will open after one half revolution, but contact W closes. The motor will stay in this position and, consequently, the valve it operates also remains in the same position until the controlled variable changes sufficiently to move the mercury switch to H. When this occurs, the motor moves through the other half of the cycle, thus reversing the valve position. The linkage may be adjusted so that the valve may not move completely from full open to full closed.

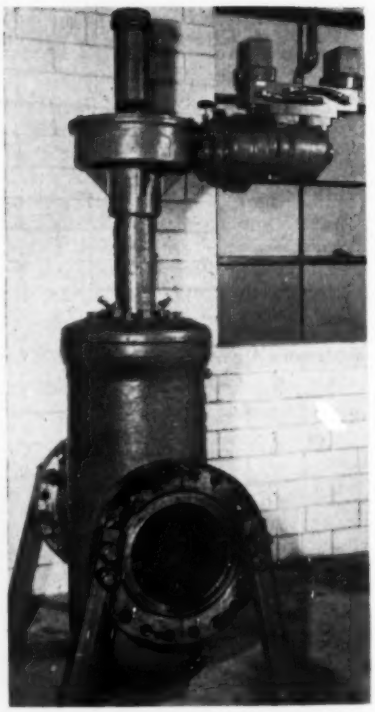
Floating Control

In the floating control, the valve either is moving toward the open or closed position, unless the controller switch is at a neutral. Then the valve remains in a set position. It does not move until the controlled variable moves above or below this neutral zone. Floating control is obtained by using a reversible motor to operate the valve at a slow speed. Fig 92 shows the operation of the motor circuit that has a set of stator windings for each direction and two tandem connected rotors. In the diagram, the mercury switch is shown in a neutral position. When the controlled variable causes the switch to contact C and L, the coil causing the motor to open is energized. This continues until the limit switch stops the rotation or the controller switch reverses. At any time that the controller switch is in the neutral position and is not contacting either the H or L contacts, the motor remains stationary.

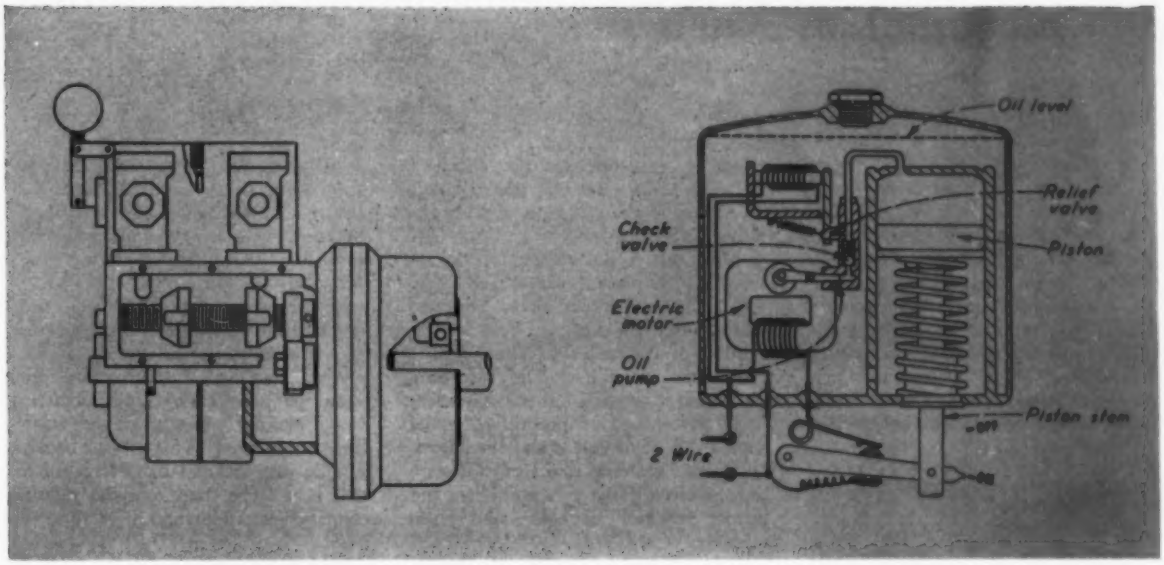
Motor operators, Fig. 93, are designed for large valves of the sliding stem type. The operator may be adjusted to apply any desired pressure of the plug on the seat. They are designed to provide a hammer blow in opening. This is advisable when the operator is used in conjunction with a gate valve. Control equipment capable of supplying a reversing current to the motor is necessary for application of these systems to automatic control.

Throttling Action

For use in modern control systems, the motor operated valve must be adapted to proportional control. In proportional control there is a valve position to correspond to each valve of the controlled variable within the proportional band. Thus, the valve must go from full open to completely closed position as the controlled variable moves from one extreme of the proportional band

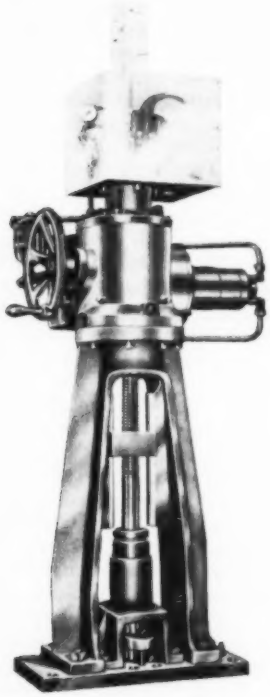


95 Reversible operation is accomplished with a solenoid piloted gas motor



96 *Limit stops contact fingers, which operate valves controlling flow of air or gas to control pneumatic motor*

98 *Valve stem moves to down position and holds until the small magnetic relief valve dissipates the pressure*



97 *Accurate opening is accomplished with a reversible pneumatic motor*

to the other. To accomplish this, a circuit as shown in Fig. 94 may be employed. Positioning of the valve withing its full stroke must position a slide wire resistance in direct relation to the location of the valve of the controlled variable within the proportional band. These resistors are made the legs of a Wheatstone bridge circuit. A balancing relay operates the motor in the necessary direction in order to set the valve resistor at a position equal to the controller resistor. This system for positioning a motor operated valve may be used on most valves, which have a reversible motor. To accomplish this, a position transmitter is used to position a slide wire resistance, which is placed in the controller to evaluate the valve position.

Gas Motors

Conventional reversible gas motors of the rotary or piston type have been adapted for use in operating valves of almost all designs, including sliding stem, butterfly, or plug valves, Fig. 95. Operators designed for electric motor may be driven with a gas motor. The reversing is accomplished with a four-way solenoid or diaphragm-operated pilot valve. This method of operation becomes floating control similar to the system described under electric motors. The valve continues to move in one direction until it reaches the limit switch, or the affect upon the controlled variable is such that the direction of the valve is reversed. Special features, the same as those embodied in the electrically controlled valve, make possible the controlling of the force upon the seat in the closed position and to accelerate the motor before the opening motion begins.

One very successful form of pneumatic motor control is shown in Fig. 96. The limit stops contact fingers, which operate valves to control the flow of high pressure air or gas that motivates the motor. The limit cams are keyed in one position so that they move backward or forward without change in relation to each other, while the cam shaft is rotated by the driving motor.

Many desirable features have been incorporated in the valve operator in Fig. 97. Accurate positioning relative to a control impulse, motor reversal, manual operator, and ability to stay in one position on air failure are some of these features. This device is a gear-operated screw stem. The gear is rotated by a reversible gas motor. The position of the stem is detected and transmitted to the relay, which regulates the direction and speed of the motor to obtain the position dictated. This system may be adapted on most types of valves.

Electric current may be used to operate a small high pressure oil pump, Fig. 98. High pressure oil moves the piston to operate the stem of the valve. The valve stem moves to the down position and holds until the small magnetic relief valve allows the pressure to be dissipated so that the spring may move the valve in the opposite direction. The loss of current will allow the spring to operate the valve as the relief valve.

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Measurement of Variables

Previous sections of this summary have dealt with the body of the valve, including structural design and flow characteristics, and subsequently the actuators or methods of setting the opening in the body. The practical application of the body and topworks requires a third function. This is the evaluation of the variable, which is to be controlled, and the manner in which this control requires the actuator to set the valve position. Discussion of this phase of valve operation, of necessity, becomes a discussion of the first consideration in the selection of a control valve or regulator.

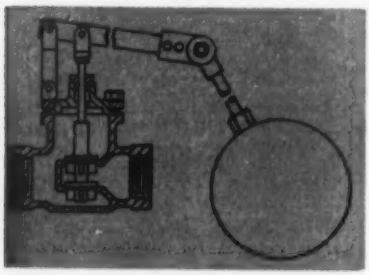
More has been written about the selection of control valves and regulators than about any other phase of instrumentation, with the possible exception of the various functions of a pneumatic controller. The foregoing portion of this article has covered a very large percentage of the variations of standard control valves and regulators. Using this material and the following suggestions will act as a guide, for the proper selection of equipment from suppliers.

In the author's opinion, the design engineer and most particularly the instrument engineer is valuable for his knowledge of standard equipment available from reputable manufacturers. There may be instances where gadgeteering is useful, but practically every valve need may be satisfied by an item from some supplier's standard line. Every effort should be made to confine the selection to standard metals, packing methods, sizes, and design, unless completely satisfied that the situation is an exceptional problem and breaks the rules.

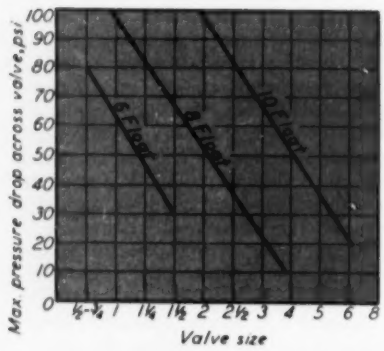
It would seem that a good way to go about picking a control valve would be to sit down and talk it over. First, what is the valve going to accomplish? Is it for the control of level, temperature, flow, or pressure? Actually, all controls are for flow, but it is desirable to know what happens when the flow is changed so it meets specific demands. First, whether the control valve will be operated by the pneumatic or electrical output of a controller. Second, when should a controller be employed. One general statement is that a controller should be used when the self-actuating valves do not give the degree of refinement desired. This may be because a wide proportional band is required, that is, a large change in the variable to make a small change in valve movement.

Of course, this is not the same as the effect of change in flow rate upon the apparent set point of, for example, a spring-loaded pressure regulator. A controller is also utilized to add refinements such as automatic reset and second derivative control. In addition to this a booster effect can be obtained with some self-operated pressure regulators, which may solve the problem. Again, a controller is ideal for any installation calling for a valve positioner (I & P April and May 1952) as this very useful gadget requires the output of the controller for its operation. A controller is called for when the necessity for recording, transmission, or resetting another instrument offers an economical advantage. Of course, a controller should be applied only when necessary.

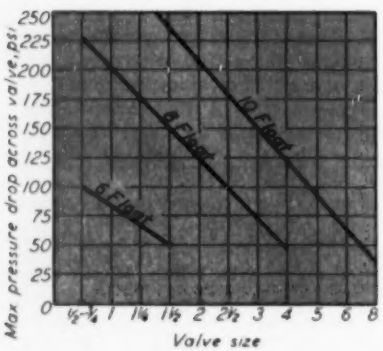
Actually controller application depends upon its function. For example, it would not be applicable in the gas distribution business, for tank heating, level control, or industrial or domestic water service. But, it would be utilized in the field of city gate gas meter stations, chemical plants, refineries, or steam-electric stations. Assuming some one of the foregoing considerations has not already caused a decision to use a controller, possibly the best approach is to start with the simplest valve to see just how uncomplicated an installation can be made.



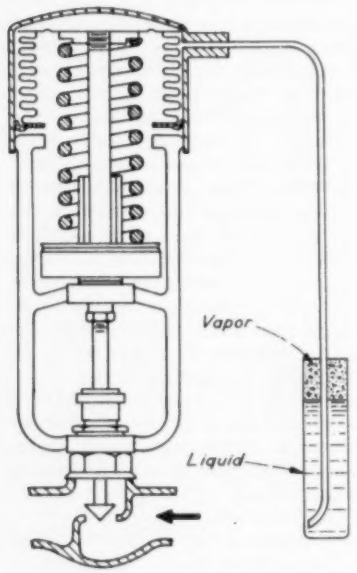
99 Direct connected floats can be used with either single or double seats



100 Relationship between pressure drop and valve size with rising stem



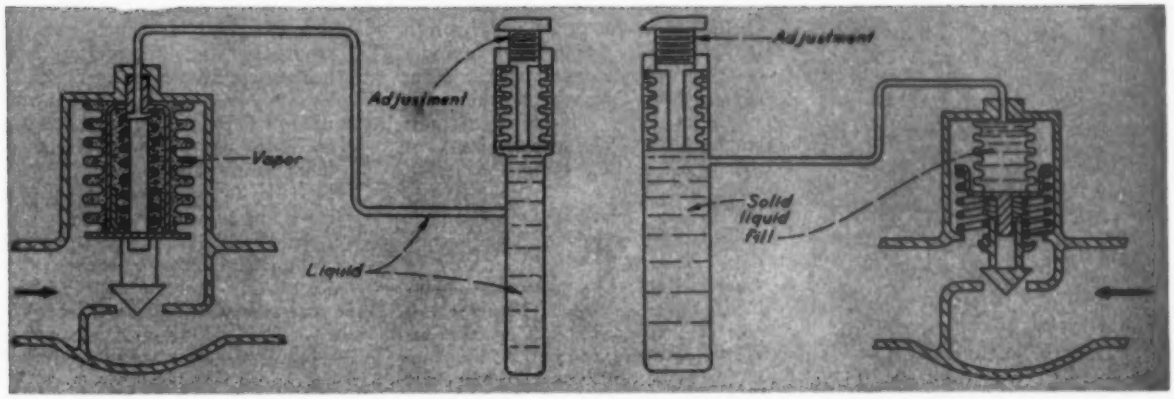
101 Relationship between pressure drop and valve size with rotating stem



102 Liquid in bulb and capillary tube vaporizes and expands in bellows

Liquid Level

Liquid level seems to be about as easy a variable as any to handle. Each classification will bring the necessity for this decision. For example, suppose a storage tank is set on a hill to furnish water for a few oil well pump engines, a drilling rig, and a few scattered houses. The tank has a capacity for about three days' operation and a



103 Expansion of liquid in the sensing element forces it into bellows where it vaporizes to close the valve

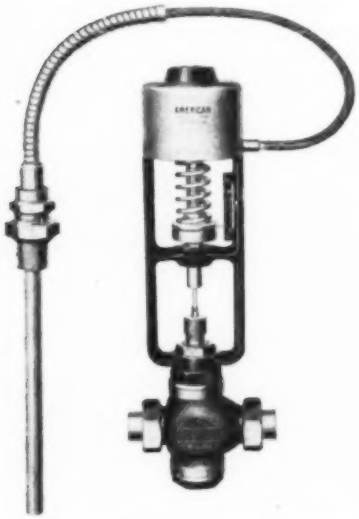
104 In this system the bulb and bellows are filled with liquid. Pressure is exerted only by expanding liquid

large supply line from the water source. It also has a target level indicator visible from many points of operating activity. What is easier than to drive up the first thing in the morning every three days and open the valve? Very little experience is necessary to estimate how long it will be before the tank is full, and the valve must be closed. Even if there is a miss, and a little water is spilled, it is not too disastrous.

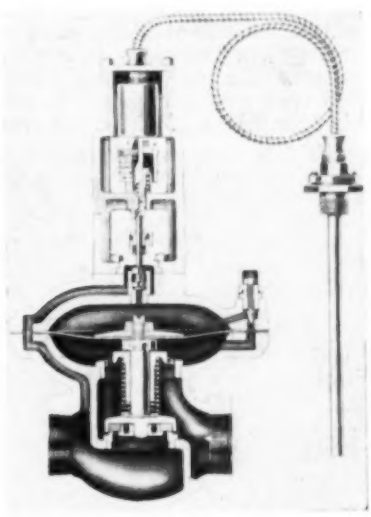
Now what happens when a drilling campaign starts with five rigs running and more houses occupied? The tank goes dry some night and the rigs are shut down due to no boiler water until someone goes up to open the valve. A level in this instance must be considered. The tank is essentially open even though it has a wooden cover to keep birds and animals out. First of all, a recorder is not needed, and secondly there is no air available anyway, so obviously a controller cannot be used. Because of the simple function involved either a direct operating float or a float operating a pilot on a small water line to operate the main valve will be required.

Direct connected floats may be used for single seated valves up to and including 2 in. size. If positive shut-off is not necessary so that the double seated valve, Fig. 99, may be used, one as large as 4 in. might be considered if the water pressure is not too high, possibly not more than 20 psi. If a larger valve is needed it will be advisable to use a float valve with a float operated pilot. This pilot may admit line pressure to the top of an actuator to open the valve, which closes upon release of pressure as the water level carries the float upward. Another internal pilot type of valve allows high side pressure to be admitted through the body to the actuator, thus holding the valve closed. Lowering the water level and the float releases the pressure holding the plug closed, and the valve opens by means of the line pressure on the plug itself.

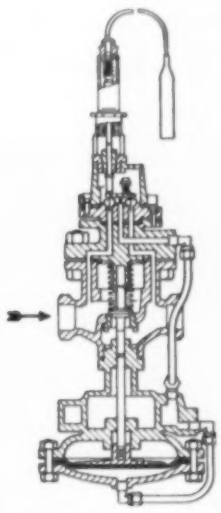
The most versatile system is to use a diaphragm motor valve, preferably single seated for tight closing. A small static line is run from the high pressure side of the valve to the diaphragm and then to a small float operated valve. This float valve is small and inexpensive. Depending upon whether it is best to run the tank over or to use up the water in the tank upon failure of the system, an open-on-loss-of-pressure or close-on-loss-of-pressure type of valve should be selected. If



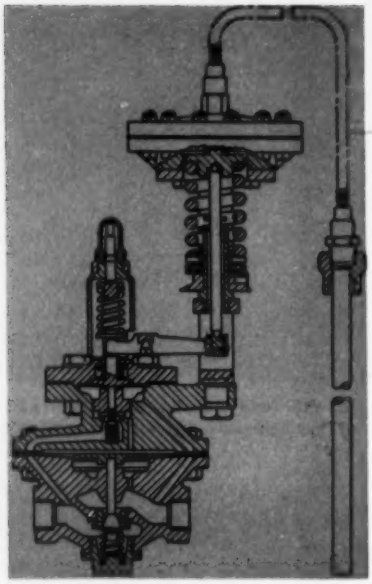
105 Spring loaded direct acting temperature regulator has wide usage



106 Small valve positioned by thermobulb pilots main valve operation



107 Pilot introduces steam to the condensate chamber to open the valve



108 Set point held accurately by steam pressure as the temperature drops

the close-on-loss-of-pressure type is selected, a float valve is employed that will close as the level drops so that pressure is built up in the static line that will open the main valve with this use of water.

The discussion so far has given an approach in selecting the actuator, but what about valve characteristic? The beveled disc has a good characteristic for narrow throttling range applications. These occur when a large change in flow is desired for a small change in variable. The variable in this case is level. The use of the float arm limits operation to a comparatively narrow throttling range so the beveled disc or even flat disc should be ideal. Before selecting this type, a look at the rest of the system is necessary. If opening this large valve is going to pull down the pressure on the supply line so rapidly that other services will suffer, a V port or parabolic plug should be considered that will give a more gradual change in flow and still be capable of supplying full capacity of the valve if needed.

Another problem is dealing with an oil trap, acid tank, or any vessel, which must be closed and possibly kept under pressure. Although this article is not supposed to deal with anything but valves, it seems difficult to tell just where to stop. The types of floats for this service are still within the classification of actuators. The float ball may be installed inside the vessel. The kidney connected to nozzles on the tank has the advantage in that it may be removed for repair or cleaning. Furthermore, the kidney will tend to eliminate wild surges in an open tank, thus protecting the float arm from undue strains. The point at which the level is to be controlled may be varied by moving the kidney, assuming the nozzles have been installed widely separated for this contingency. This is much less difficult than changing the position of the internal float.

As is the case with the open tank float, consideration must be given to the power required to operate the valve. Fig. 100 and 101 are curves shown as a guide to the limits of size and pressure drop for float valves. The rising stem valve is indicated in Fig. 100 and the rotating stem valve in Fig. 101. A direct connected float cage and valve has no packing, so friction is at a minimum. But, it must be remembered that the same liquid handled by the valve operates the float. This system is the answer to a drainer when a trap large enough cannot be obtained for the service. This float valve may be used as a feeder to a heat exchanger but must be installed with the float cage below the valve.

Head pressure change with liquid level change is used for control of the level. A reference static head is established with a constant head tank placed at the desired level point. This is piped to one side of a pilot valve. The other side of the pilot valve diaphragm is connected to the tank at the level of the pilot valve. Any difference in level will operate the pilot, which in turn operates the main valve. The term altitude is apropos as the valve is widely used on elevated water storage tanks with the valve installed on the ground. The pilot system may be arranged to accomplish the following variations in operation:

Two-way flow — valve closes at predetermined high level but opens for return flow when line pressure falls below tank head pressure.

Two-way flow with differential control — valve closes at high level but opens for return flow at a selected line pressure valve.

One-way flow — valve closes at predetermined level and opens at selected low level. Outflow from reservoir is through another line.

Most other level controls employ the controller with bubbler differential element or float actuated controller. The problem then reverts to selection of the control valve.

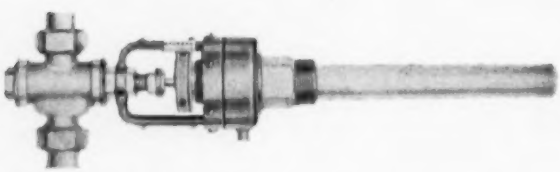
Temperature Valves

There are not so many types of application for which direct-operated temperature valves may be used. Although the variety of applications is small, the number of valves in use is tremendous. Temperature valves are used to control the flow of heating or cooling mediums through sumberged coils or heat exchangers and to control fired heaters.

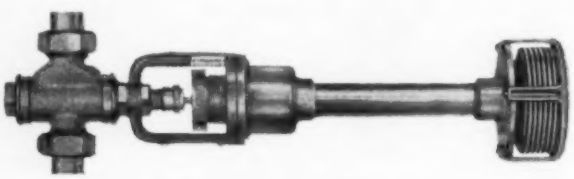
Vapor pressure systems, Fig. 102, are widely used, because a properly designed system will continue to move the valve until it reaches equilibrium with a spring or weight. The main precaution is to use a bulb with sufficient capacity so that neither expansion due to temperature range nor volume due to expansion of the bellows, which moves the valve, will allow vapor to enter the capillary tube. While vapor is acting on the fluid in the bulb, the system operates on the basis of the vapor pressure of the filling fluid. When vapor enters the capillary tube system, the effect depends upon the expansion characteristics of the vapor. This expansion may be very erratic.

Pressure of the vapor is used in a different manner in the hot-chamber-type regulator, Fig. 103. Expansion of the volatile liquid in the sensing element forces a small portion of the liquid into the bellows chamber. This chamber is surrounded by steam, and the liquid vaporizes to close the valve. The valve opens when condensation of the vapor causes a cooling of the sensing tube and pulls the liquid back onto the capillary tube.

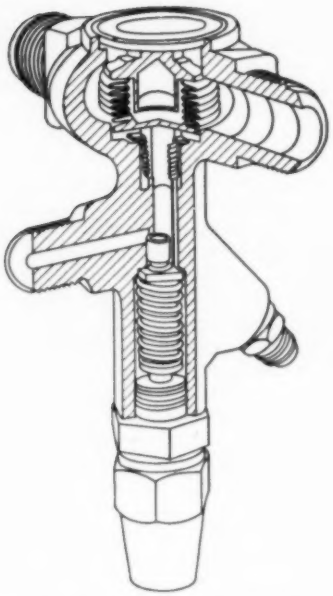
Temperature regulators may be filled



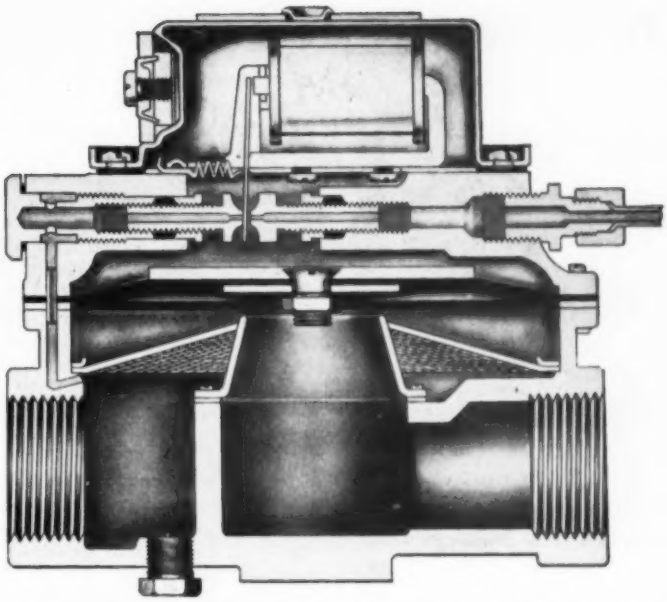
109 This valve is directly connected to the element and is placed in the vessel when the valve is installed



110 Removable bellows head is placed on an extension so that the valve element may be installed in the vessel



111 Suction gas temperature controls flow of refrigerant to evaporator



112 Thermocouple in gas pilot flame generates current, which is controlled by room thermostat. Coil actuated flapper opens the supply or bleed nozzles

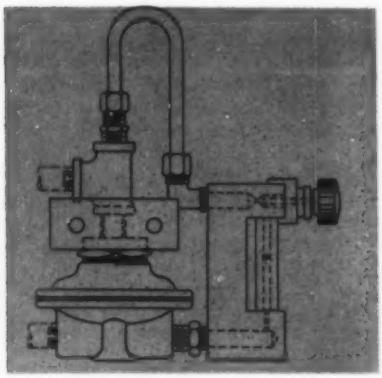
completely with liquid, Fig. 104, so that the valve plug is moved by expansion of the liquid. The selection of a liquid with vapor pressure or expansion characteristic to operate a valve through the desired limits is a very specialized phase of successful temperature regulator design. Manufacturers of these valves have selected suitable liquids to fit the design and size of their valves for the operating conditions specified.

Fig. 105 shows a direct-acting temperature regulator. Due to the fact that the movement of the valve is caused by the expansion of the liquid or gas in the bulb, valve sizes and operating pressures are limited. Valves of this direct-operated type are furnished as large as 6 in. This size should not be used with a pressure drop of more than 30 psi. This 6 in. valve is a standard product, but it would seem advisable to look quite carefully at other approaches if the flow of heating medium requires larger than a 3 in. valve. Most applications using a submerged coil are for heating large volumes of liquid. This is an ideal place to use the quick opening valve giving on-off action. The large capacity lag allows pouring a vast amount of heat into the liquid until the temperature-sensitive element reaches the cutoff point, and then remains in the shutoff position entirely for a definite period.

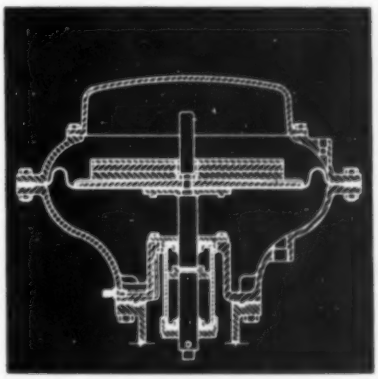
Using body and trim of bronze minimizes the leakage, which is caused by unequal expansion of the parts of a double seated valve. As the double port valve will allow the self-acting temperature valve to be applicable in larger sizes with greater pressure drops they should be considered. Nevertheless, the single-seated valve should be investigated if the tank is going to be idle for long periods with little use of liquid.

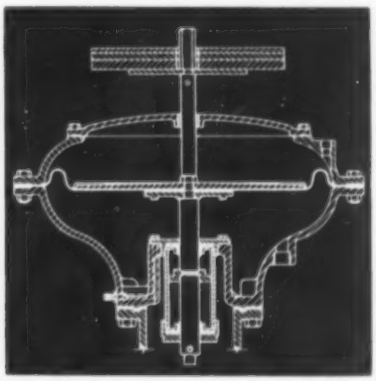
Change in temperature setting of fluid-filled temperature regulators is obtained by varying the effective tension, either by a change of force on the weight or spring or change in volume of the fluid in the control system.

Valves operating with a high pressure drop across the seat or a large sized valve must be pilot operated, Fig. 106. For these services a temperature element operates a pilot, which allows line pressure to position the valve.

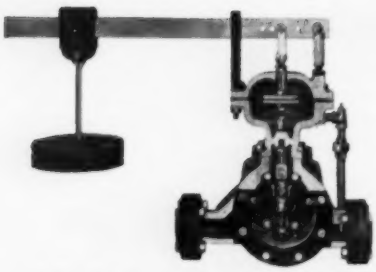


113 Differential valve maintains constant small flow to purge system

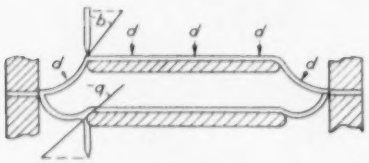




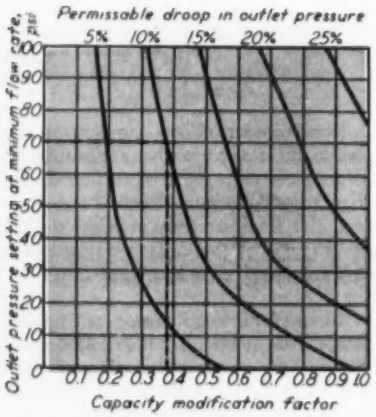
114 & 115 Weight as balance is most straightforward method of measuring a pressure. Balance is obtained when flow exerts pressure equal to weight



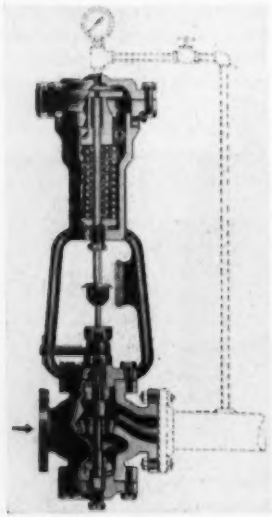
116 Weight is on an extended arm to increase range of the regulator



117 Effective area of diaphragm varies with each position within the case



118 Valve capacity factors are applied to limit control pressure deviation



119 External static pressure lines have been adapted to many applications

The valve in Fig. 107 is designed for use on steam service. A reservoir furnishes condensate to operate the diaphragm. The pilot valve introduces steam from the high side of the valve in order to open the valve and relieves pressure to the low side of the diaphragm to close the valve. This type of temperature regulator is much more sensitive to temperature changes than is the one previously described, because of the pilot. Although the throttling range is not variable, it is low, which allows the valve to move through its entire range with a change of about 4 per cent of its bulb range.

Temperature regulators, Fig. 108, will hold the set point accurately by increasing the steam pressure when the temperature falls. Reference to the illustration will show that with a cold bulb the temperature-adjusting spring lifts the pin, which in turn operates the lever. Under these conditions, the regulator will control pressure that is dictated by the pressure spring setting. When the system reaches the desired temperature, the temperature adjusting spring is set so that the valve will just close.

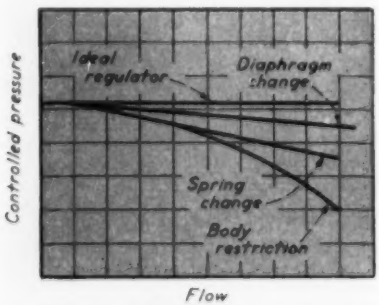
With this setting, a decrease in temperature has the effect of allowing the pressure-limit spring to exert more force, thereby increasing the discharge pressure of the regulator. An increase in temperature moves the lever to assist the spring, thus decreasing the force of the spring. Being a pressure regulator, the instrument senses a load change, which reflects itself upon steam pressure. This occurs before the effect is noticeable in the temperature, so that the valve anticipates the temperature change and partially corrects for it, even before the temperature change occurs.

Many special control valves have been developed that use the expansion of the bellows when heated. Fig. 109 shows the valve directly connected to the element. With this valve, the unit is installed in the vessel, and then the valve is piped up. Fig. 110 shows a removable bellows head placed on an extension so that the element may be installed in the vessel. This element is designed with a protective housing for use in corrosive liquids. The radiator valve is another temperature regulator. For radiator use the bellows contains water as the filling medium, so that it may operate under changes of pressure and temperature in a steam system. For other applications, a filling medium is selected that has expansion characteristics to fit the service. Many special valves have been developed for refrigeration control. Fig. 111 shows a valve in which the temperature of the suction gas to the compressor controls the flow of refrigerant.

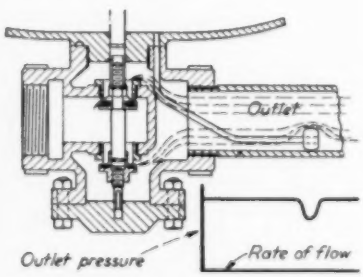
A control system for heating has been developed that does not require external electrical current supply but, nevertheless, is electrical. The power is generated by a thermocouple in a gas pilot flame. This current, controlled by a room thermostat, operates the valve, Fig. 112. The coil-actuated flapper moves to open either the supply nozzle with which to apply pressure on the diaphragm to close the valve, or it opens the bleed nozzle in order to open the valve. The valve shuts off on failure of pilot flame or generator.

Flow and Differential Control Valves

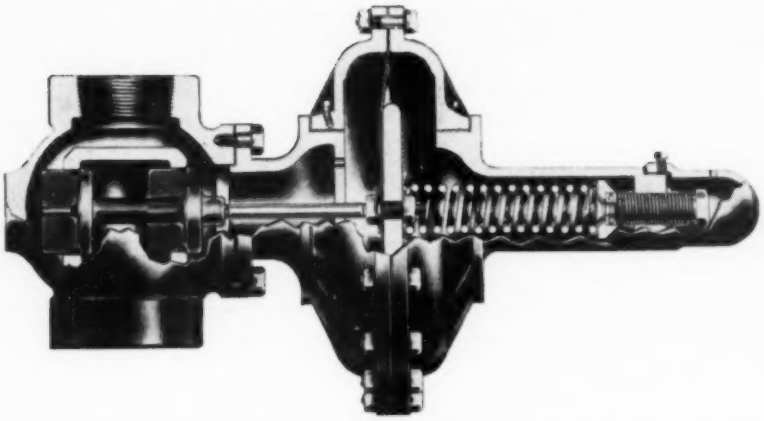
This heading may sound odd. It would seem that all types of valves control flow. This is essentially true, but in doing so the valves are controlling other variables. In the case of the temperature valve on a heat exchanger it is surely controlling flow of steam, but this is done to maintain temperature. There are some self-operated flow control valves, although most of the flow control applications are handled with a controller. It is difficult to do a good flow control job without some device such as an orifice meter to measure the flow rate. Whether the rate is measured or not, the flow may be controlled by holding



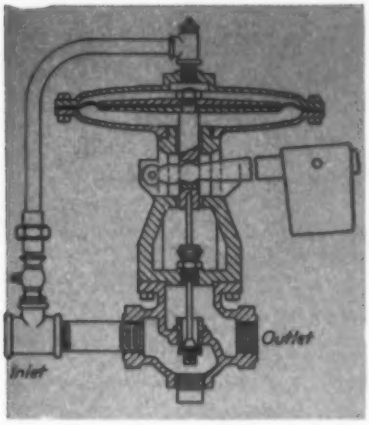
120 Deviation form control setting due to action of diaphragm and spring



121 Booster holds constant pressure by varying the pressure to diaphragm



122 Vacuum control may be obtained by installing a weight or spring-loaded regulator. Line pressure is under diaphragm and pulls spring into tension



123 Vacuum control may be obtained with a weight loaded regulator

a constant differential across an orifice or valve that may be varied for the desired flow setting.

A very prevalent application of a small valve of this type is to control purge flow to meter lines or bubbling rate for a level instrument. Fig. 113 shows the regulator with the low side static line hooked up to the discharge of a rotameter and needle valve. The same principle is employed when the differential valve is installed ahead of the feedwater control valve on a boiler with the static control points before and after the feedwater valve. This is one means of causing the valve movement to create uniform change in flow rate.

Differential control may be obtained directly in relatively small valve sizes and low pressure drops by introducing the two static pressures into the diaphragm case with the differential effect created by a spring on one side of the diaphragm. For more difficult services the small pilot should be of this differential type with the differential determined by spring or weight force. The main valve is operated by this pilot. The weight of the valve plug might be equal to or greater than the desired differential, and this must be considered when selecting the type of valve. The design of differential valves as emergency shutoff valves in case of excess flow is interesting and important but cannot be covered here. For this service many of the valves described may be used with a control system designed to operate the valve under predetermined abnormal changes in flow or pressure.

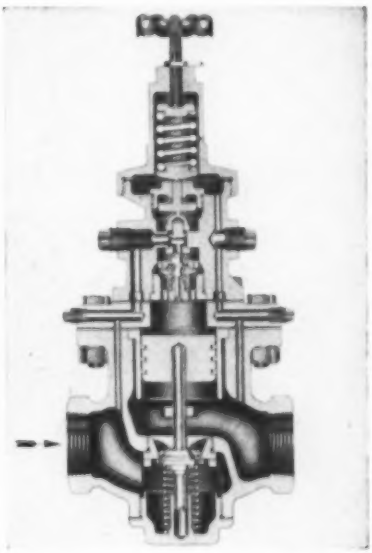
Pressure Regulators

This is an important field, and there are probably three regulators or control valves being used for pressure service as against one of all other uses combined. This statement applies to valves in service and not to different types of service, although on second thought, the ratio may hold good for types of service as well. From the standpoint of number of valves it is not hard to justify the three-to-one statement when usage is investigated. As low-pressure gas distribution systems are disappearing, a gas regulator for each house is required. The same is true of water systems. Specific requirements of steam-operated equipment necessitate control of the steam pressure from the main header. Every pneumatic controller, whether for temperature, liquid level, or whatever it may be, operates on a controlled supply of constant pressure, air, gas, or liquid. This should be enough to go on with the considerations of the pressure-sensing systems and their relation to selection of a valve.

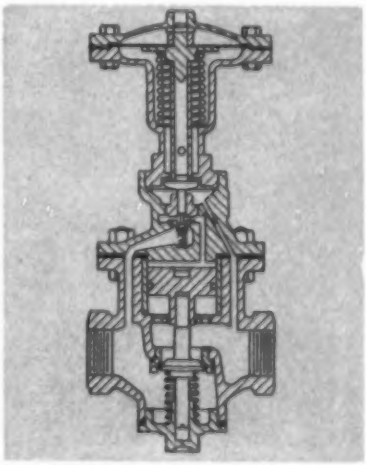
Weight Loading

Use of a weight as the balance is the most straightforward way to measure a pressure or weight. Thus, the pressure of the line being exerted on one side of the diaphragm of the topworks, Fig. 114 and 115, may be balanced by weight on the other side of the diaphragm. A balance is obtained when the valve is opened sufficiently to allow the flowing medium to exert pressure, which will equalize the effect of the weight. This may also be accomplished, Fig. 116, with the advantage of having the application of weight on an extended arm, thus reducing the amount of weight required.

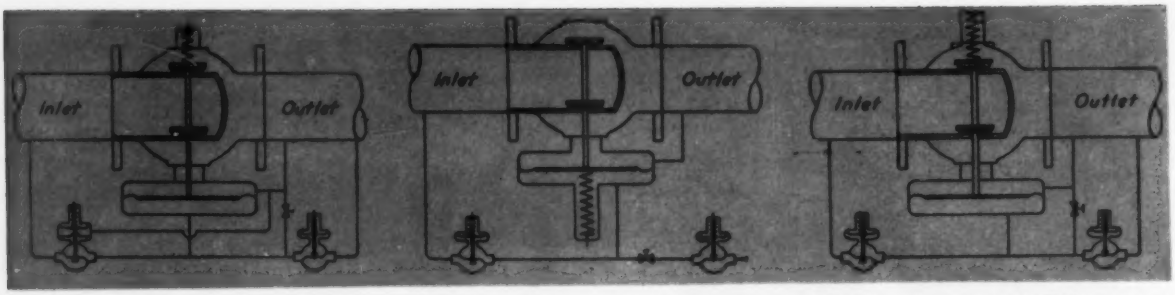
Fig. 117 shows that the effective area of a diaphragm varies with each position within the diaphragm case and becomes a maximum in the raised position. This variation depends upon



124 Self-contained pressure regulators are designed to include the pilot



125 This regulator design permits remote positioning of the set point



126 Equalizing spring opposes loading while pilot bleeds to downstream

127 Differential spring loading can reduce pulsations on the valve

128 Pilot directs controlled pressure to oppose the loading-spring load

the size of the diaphragm plate, the molded shape and flexibility of the diaphragm, and the length of stroke of the stem. With the diaphragm it is deduced that less line pressure is necessary to balance the weight in the open position than is necessary in a closed position. Consequently, the controlled line pressure will fall off for the increased flow rates. Curves of the type shown in Fig. 118 show the factor to be applied to the indicated valve capacity of a weight loaded regulator to limit the change in controlled pressure. An example is shown by the dotted line.

In order to limit the droop or fall-off in outlet pressure with a setting of 70 psi, it is necessary to confine the flow to 38 per cent of the maximum capacity. If the operating conditions are such that a 20 per cent droop is acceptable a smaller valve could be used, as the desired maximum flow causing this droop would be 79 per cent of the capacity of the valve.

Amount of weight necessary to obtain a desired controlled pressure may be obtained by using the following formula:

$$W = P_2A_D + (P_1 - P_2)\,A_V$$

Where:
W, weight on diaphragm, lb
P_1, inlet pressure, psi
P_2, controlled pressure, psi
A_V, area of inner value, sq in.
A_D, effective diaphragm area, sq in.

In applying this formula to a double seated valve, the value of A will be effective area causing unbalance giving consideration to the cross-section area of the stem.

Lever and Weight

Use of the above formula will show that a large weight is required even for low pressure control. Eighty-five pound would be required to hold 5 psi with a 10 psi inlet pressure when using a 1-⅛ in. dia seat with an 18 in. diaphragm. The weight may be decreased by using it on the end of a lever, Fig. 116. This is also accomplished by the designs, which are shown in Fig. 72 and 73. These designs have many operational advantages. The formula for the weight to be used for these regulators is as follows:

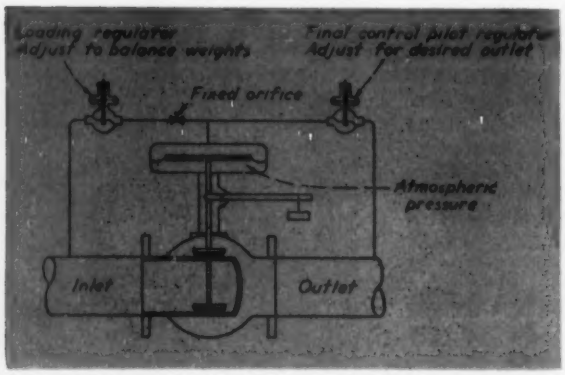
$$W_L = \frac{L_1}{L_2} P_2A_D + (P_1 - P_2)\,A_V$$

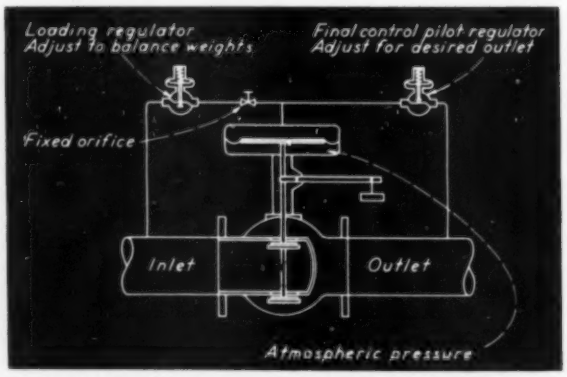
Where:
W_L, weight to be used, lb
L_1, distance, fulcrum to stem
L_2, distance, fulcrum to weight

This discussion has assumed that the weight loading is supplied to a diaphragm. The use of a piston has certain advantages. Some of these advantages are: constant effective area, unlimited stroke, and adaptability to high temperatures. Its disadvantage is formidable because of the difficulty there is in establishing proper seal without unpredictable friction effect.

Spring Loading

Characteristics of a spring make possible its use as the measuring force to replace the weights. Fig. 61 shows one of the innumerable forms of spring loaded valve in which the controlled medium is in contact with the diaphragm within the body of the valve. This design minimizes friction losses, which are caused by packing. The spring may be used as shown in Fig. 119. This design has the advantage of offering the possibility of sealing the diaphragm with some product other than that in the line. Cooling of the product is also possible before it comes in contact with the diaphragm. With this design, the static tap, which operates the valve, may be located at the exact point that is to be controlled, rather than immediately following the valve orifice.





129 & 130 Constant force of a weight and beam is employed to operate the line valve, which is being loaded instead of balance loaded. One side of the diaphragm is open to atmosphere. Inlet pilot is adjusted to balance weight

Success of the spring loaded valve has been dependent upon design and selection of the spring. This may be shown by following the action of a reducing regulator. Assuming a controlled pressure, which is below the setting of the spring force, the valve will be open enough to allow pressure to build up. Pressure will build up until equilibrium is reached between the line pressure on one side of the diaphragm, the spring on the other, and the differential across the valve acting on the plug surface. When this equilibrium is reached, the pressure will remain constant.

An increased use of the commodity will tend to decrease the controlled pressure, thus allowing the spring to open the valve again in order to establish equilibrium. This will be done at an extended position of the spring and at a correspondingly lower pressure. Flow characteristics are shown in Fig. 120. This illustration also shows the added affect of friction loss through the valve body. An abnormally low control pressure will be the result of the use of a static device, Fig. 121. This decrease is accentuated by increased flow so that the pressure control point is essentially increased. Many methods of boosting are used in the gas industry.

Force exerted by a spring is equal to the spring gradient in pounds load per inch of travel, times the length of travel in inches. From this relationship it can be seen that the variation from the set point of a regulator is less with a spring, which has a low gradient. Selection of a spring may be made by substituting spring gradient times length of travel for weight in the equation discussed under weight-loaded regulators. Reference to tables of spring characteristics will show a spring with the correct gradient used to operate through travel that is dictated by the design of the valve.

Pressure regulators for use on gas service at low pressures, 3 to 10 in. of water and low flows, below 10,000 cfh, may be selected from the many well designed regulators for this application. The service desired for the regulator will determine the special features. As shown in Fig. 61 through 66, these are furnished with low supply pressure shutoff, excess discharge pressure relief atmospheric vent with insect-proof cap and interchangeable diaphragm-to-body relationship. Care should be exercised in sizing these valves so that the desired volume may be put through the valve with the acceptable drop in controlled pressure. Do not forget to consider a pressure booster, such as is shown in Fig. 121.

It has been stated that the term *diaphragm motor valve* is used to designate the control valve of the same design as those which have been discussed, except that this valve operates through its complete capacity with a given range of pressure on the diaphragm. This pressure is usually from 3 to 15 psi. For this valve, the spring-to-diaphragm relationship must be such that this 3 to 15 psi will have power to position the valve and also have stability with which to overcome the unbalance. Thus, with 9 psi on the diaphragm, the valve must be half open. When the unbalance becomes excessive, a valve positioner is used, unless another type of topworks is selected.

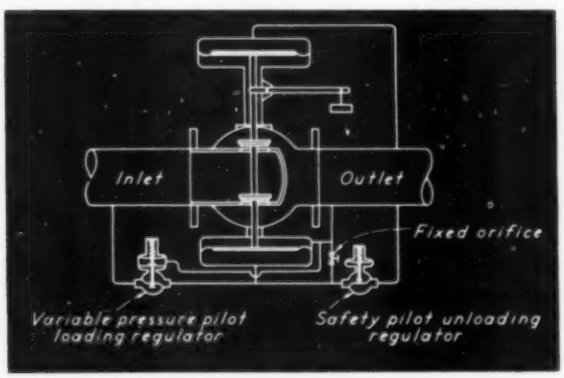
Vacuum control may be obtained by the use of a weight or a spring-loaded regulator. As the vacuum will be less than atmospheric pressure, the line pressure is under the diaphragm and pulls down to place the spring in tension. The action will be such that a constant vacuum is held on the inlet of the valve, Fig. 122. The same measurement may be made by using weights, Fig. 123.

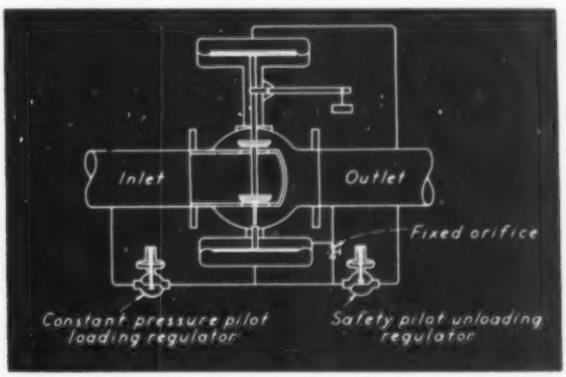
Pressure differential is measured by introducing a reference pressure on one side of the diaphragm in addition to a spring or weight. The controlled pressure is exerted on the opposite side of a diaphragm and must balance the reference pressure plus the spring loading.

Pilot Loading

Very accurate small pilot valves have been produced that are based on the principles of the design of spring-loaded regulators. The pilot valve with direct spring loading is used to load a balanced diaphragm valve, Fig 25 and 26. Self-contained pressure regulators, Fig. 124, have been designed to include the pilot with the valve. The equipment shown is a diaphragm-operated reducing regulator. In the design of this system, as in other balanced types, a change in controlled pressure is reflected immediately in an unbalance between the line side of the diaphragm (in this case) and the force being exerted above the diaphragm. Action of the pilot to change the loading on the diaphragm is a vernier adjustment to the effect of this unbalance. The valve may be designed as shown in Fig. 125. This design facilitates remote positioning of the set point. Instead of the spring being adjusted by a hand wheel, it is adjusted by the movement of a diaphragm in the topworks of the pilot valve. This positioning is accomplished by varying the loading pressure to the topworks of the pilot valve from a remote location.

Pilot systems have been designed to accomplish pressure control using all variations of the balanced diaphragm valve. This valve is available as a loading pressure to close (direct acting) or pressure to open (reverse acting). The design may be varied to obtain a valve in which a spring acts with the loading pressure or against the loading pressure.





131 & 132 Conventional weight loading has been added to the pilot systems in these two illustrations. Upon failure of the lower balance diaphragm or pilot loading closer, the balanced diaphragm loses contact with stem

Mr. Allen D. MacLean, Chief Engineer of the Chaplin Fulton Mfg Co, has presented a very straightforward and clear nomenclature for the many variations of pilot systems now in use, as well as an analysis of the operating characteristics. His methods of classification and analysis are being used with Mr. MacLean's permission. The simplest form of pilot loading was shown as an example of this type of actuator. By the method of classification this would be *pilot regulator, constant pressure, balance loading, reverse acting, no equalizing spring.*

Fig. 126 shows the system with the addition of an equalizing spring opposing loading and a safety pilot unloading regulator, but with the bleed back into the line downstream of the regulator. In this system the spring assists the constant loading pressure to overcome excess pressure required to cause flow across the restricting orifice and back into the line.

Differential Spring Loading

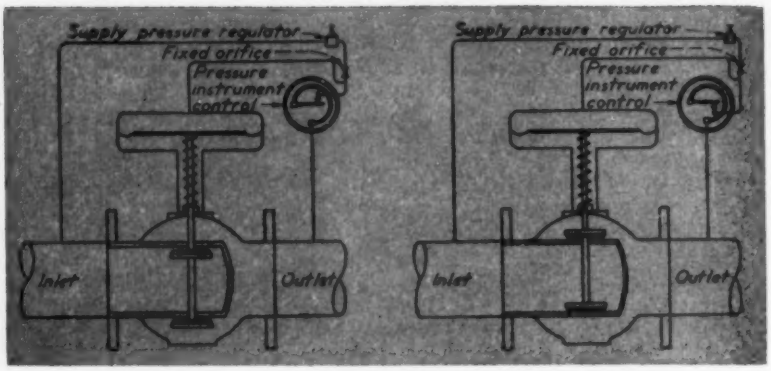
Differential spring loading reduces pulsation. The spring will open the valve under emergency conditions or close the valve, depending upon how the spring is installed. Fig. 127 shows a system classified as *pilot regulator, constant pressure, balance loading, reverse acting, spring acts with loading.*

Additional pilot control systems employ a double diaphragm pilot in which the controlled pressure may be exerted to oppose the loading—spring loading. This pilot may be direct or reverse acting. The double diaphragm pilot is used in Fig. 128 to obtain a *pilot regulator, variable pressure, balance loading, reverse acting, spring opposes loading* system. Additional use of this pilot is shown in Fig. 132.

Constant force of a weight and beam is used in Fig. 129 and 130 to operate line valve. The line valve is being *loaded* instead of *balance loaded* because one side of the diaphragm is open to atmosphere. In operation, the inlet pilot is adjusted to balance the force of the weight. The restricting orifice allows the control pilot to load or unload the diaphragm as dictated by the change in the downstream pressure until the downstream pressure equals the setting of the control regulator.

Conventional weight loading has been added to the pilot systems, Fig. 131 and 132. Upon failure of the lower balance diaphragm or the pilot loading regulator closer, the balanced diaphragm will fall and lose contact with the valve stem so that the weight loaded system becomes operative.

Frequent mention has been made of instrument control. Although the controller, and more particularly the pressure controller, is no more than a highly developed pilot into which refinements or variations of action may be designed, this article will only consider the controller from the standpoint of its effect upon the control valve. Upon this basis the action of a pressure controller is either *instrument control, variable pressure loading, bleed to atmosphere, direct acting,* Fig. 133, or *instrument control, variable pressure loading, bleed to atmosphere, reverse loading,* Fig. 134.



133 & 134 Pressure controllers are highly developed pilots into which refinements or variations of the valve have been designed

Table 3, which has been developed by Mr. MacLean, should be very helpful as a guide in selecting a pressure regulator system. Economics, engineering considerations and, believe it or not, personal preference, will dictate the style of body to be used in the system.

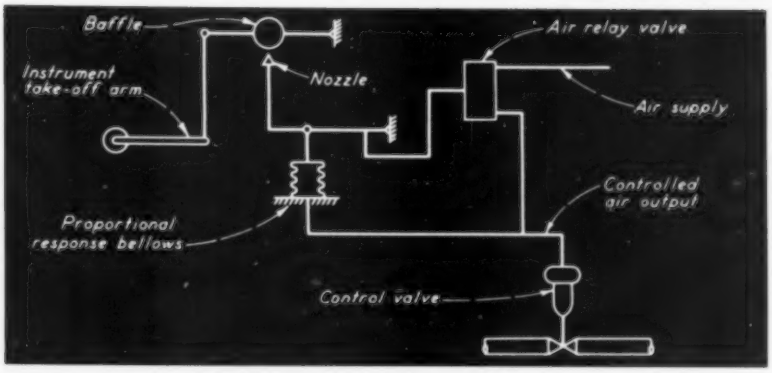
Control Valve

Each time in this article that the discussion of the direct-operated regulator whether for pressure, level, differential, or temperature reached the point of consideration of instrument control the discussion stopped. At this point, by discussing the control valve, this large percentage of valve applications using the instrument control and control valve is covered. The automatic controller is an instrument, which measures a variable. It supplies an air or liquid output pressure to the valve in the system in proportion to this variable.

Primary elements have been developed to measure practically all of the physical and chemical variables, from pressure and temperature, through pH, speed, and oxygen concentration. No matter what variable is being measured, the controller supplies an output, which is proportional to this value between a maximum and minimum. Most controllers vary the output between 3 and 15 psi, although other ranges are used. At present, the Scientific Apparatus Manufacturers' Assn is considering standards to include 3-15, 3-27 and 6-54 psi. The control valve moves from fully closed to completely open, using this output pressure range on the actuator. The actuator may be actuated electrically, hydraulically, pneumatically, or even by gravity. As has been pointed out earlier, the control valve is a high-lift valve with flow characteristics selected to suit the process as nearly as is possible.

Reference to the summary in the early part of this article will show that a wide variety of characteristics is available. Although *high lift* is a term normally used to apply to globe valves, it may also apply to other designs. For best control, the valve must require sufficient movement whether linear, rotary, or whatever it may be, so that appreciable movement is obtained with small changes in controller output. Actually, the only difference between a regulator and a control valve is that the control valve is a unit of a control system and has an actuator calibrated to the output of the controller rather than to the variable being controlled. Unless a valve positioner is used in conjunction with the motor valve, the valve stem position will be directly proportional to the instantaneous output of the controller under ideal operation. The operation that employs a valve positioner is mentioned, because the use of a positioner makes possible reversing the movement of the stem with reference to the output of the controller, as well as to obtain full movement of the valve with less than the full range of controller output.

Fig. 135 shows the conventional pneumatic control system in which the controller may be measuring any of the variables mentioned. A source of dry,



135 Conventional pneumatic control system that measures variables. Dry, clean gas or air is supplied to the controller at a constant rate of pressure

clean gas or air is supplied to the controller at a constant pressure. The mechanism of the controller furnishes a pressure to the control valve, which varies with the measured variable. The manner of this variation is entirely dependent upon the design of the controller. Fig. 91 shows the electric control valve circuit, which is used to accomplish the same positioning of the valve in an electric system.

Balanced diaphragm valves, Fig. 48 and 14, may be used as control valves by means of applying the controller impulse to a spring-loaded small pilot valve, similar to a diaphragm control valve. This valve operates through its full lift when the full range of controller impulse is employed. But, due to its small capacity and short stem travel, it may balance the line pressure being exerted on one side of the diaphragm, very accurately.

Sizing a Valve

Engineers and designers are entirely at the mercy of the valve manufacturer when it becomes necessary to determine the size of a valve. The manufacturer is the only one who can supply the flow data for his equipment. The prospective user may use an accepted method for calculation of size and obtain the variables in the system in which the valve is to be used, but he will still be dependent upon data furnished by the manufacturer. Fortunately, the companies furnishing valves, with very few exceptions, realize the importance of having their valves operate satisfactorily as compared with selling a few more valves through unreliable operational claims.

Discrepancies in calculations of the size of a valve are not nearly as serious as incorrect analysis of the use and determination of operating conditions. A few general observations are in order.

Flow Rate

The flow sheet of the chemical plant or refinery is the starting point to obtain information for sizing valves. Always start by using the highest flow rate listed and then try to justify its existence. Watch out for a flow rate that has been increased by each engineer just to be on the safe side even though most plants of today exceed the design throughout before they have been on the line very long. Consideration of pump capacities will give a good clue to flows. It is unreasonable to size a valve for more than the pump in the system will deliver. When flow rates listed on the flow sheet are consistently much lower than the pump capacities either the pumps are being sized incorrectly or someone expects to increase the capacity of the plant over the listed flows. Flow of fuels, heating, or cooling mediums must be determined by analysis of the equipment.

Determination of flow rates in gas or water distribution systems, or in transmission lines becomes an involved analysis of the expansion rate and ultimate maximum of the system. In most cases a predetermined ultimate for each step in expansion will allow a maximum flow rate to be selected. Many applications of regulators will have had enough precedent so that well-defined limits of flow have been established.

Establishing a minimum flow is, in most cases, more difficult than determining the maximum. In many installations the minimum flow rate is zero. This is not a difficult condition in itself as many valves are designed for positive lock-up and a maximum pressure differential. It becomes difficult when the valve is called upon to handle flows from zero to a large maximum. Most applications of this type are sized for the maximum flow using a positive lock-up valve and expecting somewhat less accurate control. The low flows in this system may be handled by a small valve, which becomes active at a setting that occurs after the large valve is shut off.

Differential Pressure

Analysis of a system to determine pressure drop available across a control valve requires a common sense approach. It is not common sense arbitrarily to say that the size will be determined upon a pressure drop of 10 or 20 psi or any other value. The pressure drop, which will exist across a valve, is the difference between the sum of source pressure, less line and fitting losses on the upstream side of the valve, and the pressure required at the equipment being served plus the line loss from the control valve.

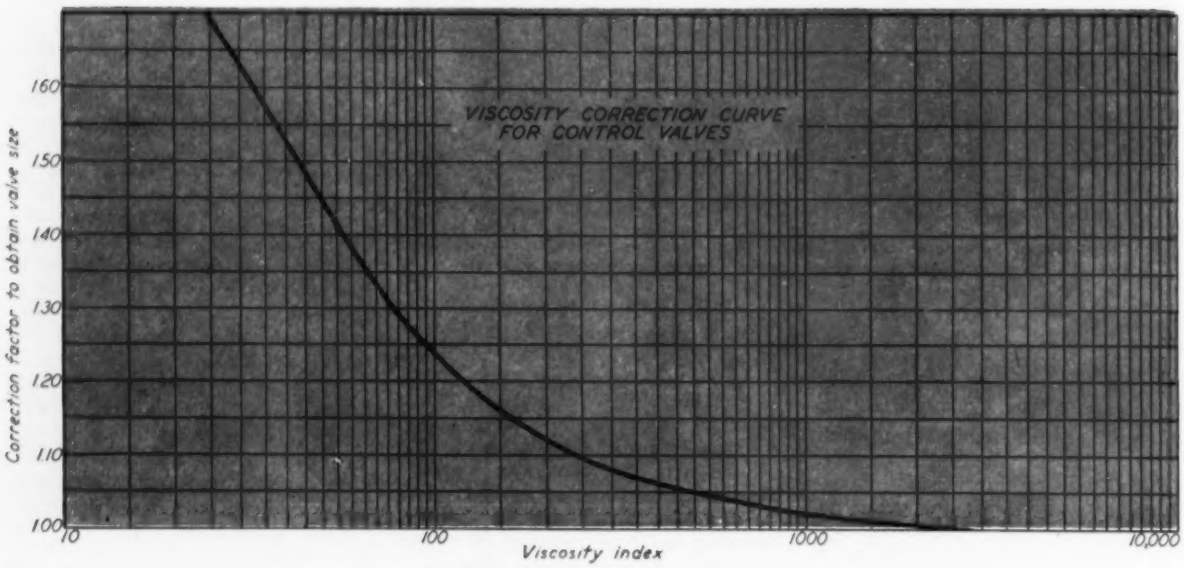
Determination of the value of differential pressure is not difficult with a large constant pressure header furnishing gas directly to a regulator holding a constant downstream pressure. The determination is not difficult when controlling a constant level in a pressure tank delivering flow to a constant pressure fractionating column. Trouble occurs when long lines and variable pump discharge rates vary the upstream pressure to the valve as the flow varies.

Look at the system very carefully if the pressure drop available through the valve is less than 10 per cent of the upstream pressure, is less than one third of the total drop of the system including the valve, or is less than 4 psi in low pressure liquid systems of a chemical process.

First consideration is to sufficient valve size in order to handle maximum flow that will occur. Under ideal conditions of little variation in differential pressure, the size is determined using this differential pressure. Under variable differential pressure conditions the minimum value of differential pressure, which will be the value at maximum flow, will be used. Analysis of this size as compared to the size required to pass minimum flow at maximum differential must be considered to determine whether the valve has rangeability to handle both conditions. A discussion of rangeability consideration follows the sizing method.

Excessively high pressure drops will require consideration of valves most readily adapted to this service. A pressure drop of 150 psi or greater is assumed to be high. This is mentioned here as the selection of a parabolic plug in a globe, angle, or S body may be advisable, and the type of plug and body may necessitate special consideration in sizing.

Viscosity of Flowing Fluids



136 Correction factors in this graph may be employed to obtain the true viscosity index value to determine the exact valve size. The product of this factor and the calculated valve orifice diameter is the required size

Quantity of Flow

Care must be exercised to be sure that the units used in starting flow are those used in the formula. The terms for liquid flow are gpm, while the terms for gas are cfh of gas at specified gravity of 1.0 at standard conditions of 60 F and 14.7 psia. Steam flow is designated in pound per hour.

Viscosity of Flowing Liquid

Viscosity index values may be determined for liquids using the following formulae:

Viscosity designated in stokes

$$\text{Viscosity index} = \frac{31.6_y}{d_t \times \text{stokes}}$$

or in Saybolt Universal Seconds

$$\text{Viscosity index} = \frac{14700V}{d_t \times \text{SSU}}$$

Where:
d_t diameter of value opening for flow under given condition
V, flow in gpm at flowing condition

Correction factors can be determined from the curve in Fig. 136. The product of this correction factor and the calculated valve orifice diameter is the required size. The valve size must be the next large nominal sized valve port available.

Looking at the curve it is evident that the correction factor is negligible for index values above 1000. It is also evident that the size of a valve would not change much with a viscosity index as low as 300. In most cases the difference between the exact valve orifice diameter and the available commercial size is sufficient to take care of the effect of viscosity.

Specific Gravity

For accurate sizing it is important to determine the gravity whether for a liquid or a gas. Liquid gravity is based on water as 1.00 and air at 60 F as 1.00. Gas and liquid specific gravities are given in Table 4. As the gravity multiplier appears as a square root in the sizing formula, variations of liquid gravity 20 per cent high or low do not have a devastating effect upon the size of valve selected. A major share of the gas regulator applications is for natural or manufactured gas having a specific gravity of about 0.600, and the square root of 0.600 or 0.80 is appreciable and should not be neglected.

Temperature Correction for Gas

This correction is again applied as a square root and is stated in absolute temperature (460 + degrees F). It becomes small enough to neglect between 30 and 150 F.

Determination of Cv for Liquid

The C_v factor may be determined by the use of a simple formula, explained previously. With this calculated C_v factor, or C_v factors published by manufacturers for the different sizes and types of valves offered, the size of valve body may be selected. A valve size is selected that will pass adequately the desired flow at the differential pressure available. Due to the quite arbitrary method of determining C_v it sometimes becomes difficult to justify going to a valve one size larger, when C_v value obtained is just slightly more than the C_v for a given valve. Only the engineer doing the sizing can decide if the maximum flow value is a true one or if it is distorted, or whether the pressure drop could be slightly greater. In most cases the engineer is justified in using the smaller valve when the calculated C_v does not exceed the C_v value of the small valve by more than 10 per cent of the difference between the C_v values of the smaller and the next larger valve.

Determination of Cv for Steam

Valve size for steam service may be determined using the C_v obtained by the formula discussed at the start of this article. This formula applies

to saturated steam. Applications involving steam wet enough or sufficiently superheated to affect the sizing will be very few. In this formula the quantity (Q) is in pound per hour. The same precautions in analyzing the system for pressure drop across the valve should be considered as were considered in liquid flow. Steam is a compressible fluid and as such conforms to the laws of critical flow. Upon this basis no increase in flow will be obtained with a pressure drop more than one half of the absolute upstream pressure. For example if the upstream pressure is 150 psia and the downstream set pressure is 50 psia, a value of 75 psi will be used in the formula and not 100 psi as might be imagined.

Flashing Liquids

Liquids will flash into a two phase system composed of a liquid phase and a vapor phase. This flashing exists when a pressure drop occurs sufficient to drop the pressure below the vaporization point of the flowing liquid at the temperature of the liquid under the higher pressure. This condition may readily be caused by the pressure drop taken through a control valve. Calculation of the effect upon valve sizing due to flashing is a very controversial subject. It is not difficult to visualize liquid flow through an orifice (valve) into an expanded pipe or vessel in a manner such that the additional vapor volume would not impede the flow.

In this visualization the flow through the orifice would all be liquid and would follow the laws of fluid flow. When the flow of the two phase product from the orifice becomes restricted to a valve body, and the direction is changed through the body, the size of the downstream chamber and discharge piping becomes an item for consideration. There are at least four approaches to the problem. The first is to use a valve sized for the amount of liquid and vapor existing on the downstream side of the valve seat. A standard approach in determining the volumes of liquid and vapor in the mixture is given in the following formula:

$$X = \frac{\text{Sp ht } (T_1 - T_2)}{H_{fg}}$$

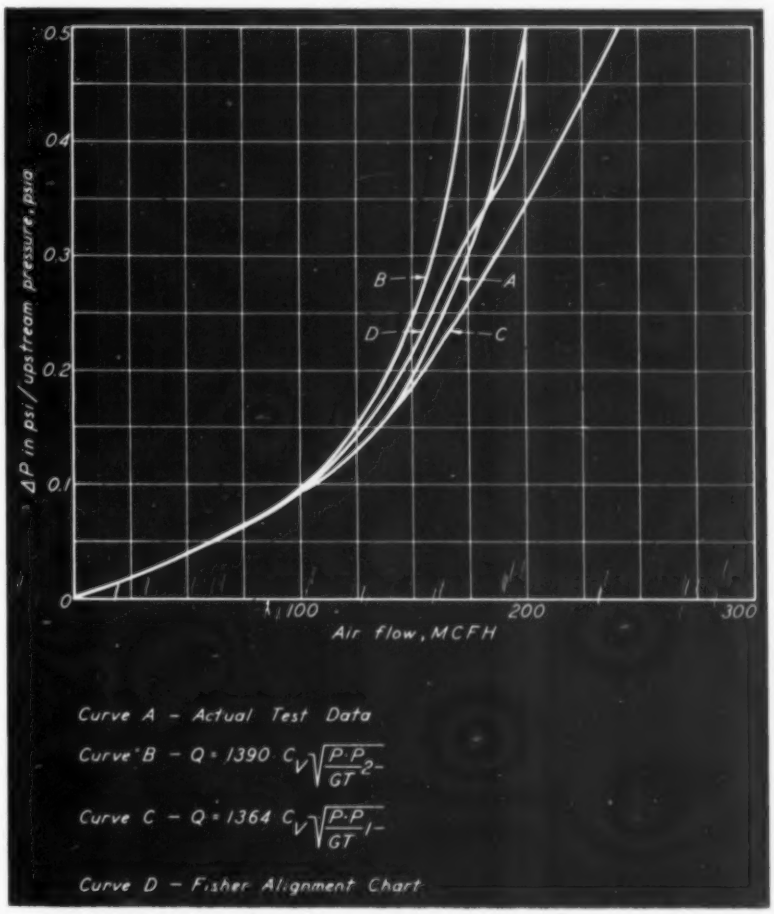
Where:
X, fraction of weight of fluid vaporizing
Sp ht, specific heat
T_1, upstream fluid temperature, F
T_2, downstream fluid temperature F
H_{fg}, Heat of vaporization—downstream pressure—Btu per lb

The second method is to calculate the value for liquid flow by installing an orifice in a body one size larger to minimize flow impedance due to friction and turbulence. The third method would employ the value required for liquid flow with emphasis on the use of increased pipe size starting at the outlet of the control valve and long enough to minimize the turbulence of flow. The fourth approach is to select a streamlined valve, thus minimizing the effect of the vapor. In this case the valve is sized for liquid flow. Attention is again called to the fact (as it was in considering viscosity effect) that the required orifice size for maximum flow may be so close to the next smaller valve that the body size selected may essentially be expanded as compared to the required size.

An effort has been made to keep personal observations at a minimum. However, it must be repeated that the decision, some years ago by most manufacturers, to discontinue making valves with a larger outlet than inlet is to be decried. Valves of this type would find use for gas service as well as flashing liquids.

Determination of Cv for Gas

This method described in the early part of this discussion may be used for a comparison of valves of all manufacturers who supply C_v data for their line. Sizing charts available from the manufacturer who has obtained these data experimentally using his equipment under varying operating conditions will be more accurate than this method. The formula exists in a form that uses the downstream pressure instead of the upstream pressure. Mr. G. F. Brockett of the Fisher Governor Co. presents a curve in his paper *Correlation of Value Sizing Methods*, Fig. 137, that shows the relation between flows through a 2 in. valve as calculated using the upstream and downstream pressures. Curve A was obtained by experimental means. Curve D, which was obtained from Fisher sizing charts, is in close agreement to the test data. Although this curve shows a maximum of 14 per cent lower flow at the critical point it justifies the use of the C_v formula in which the discharge pres-



137 Relationship between flows in 2 in. pipe valve using upstream and downstream pressures. Curve A was obtained experimentally, D obtained from sizing chart

TABLE 4—SPECIFIC GRAVITIES OF COMMON GASES

Acetylene	0.920	Hydrogen	0.069
Air	1.000	Hydrogen sulfide	1.190
Alcohol vapor	1.601	Illuminating gas	0.400
Ammonia	0.592	Methane	0.554
Butane (n)	2.005	Methylamine	1.080
Butane (iso)	2.067	Methyl chloride	1.785
Carbon dioxide	1.530	Methyl fluoride	1.195
Carbon monoxide	0.967	Natural gas	0.570
Chlorine	2.422	Nitrogen	0.971
Ethane	1.049	Nitric oxide	1.039
Ether vapor	2.586	Nitrous oxide	1.527
Ethylene	0.967	Oxygen	1.105
Fluorine	1.312	Propane	1.562
Helium	0.138	Sulfur dioxide	2.280

TABLE 5—SPECIFIC GRAVITIES OF COMMON FLUIDS

Acetic Acid	1.06	Hydrofluoric acid (conc)	0.99
Alcohol, commercial	0.83	Kerosene	0.80
Acetone	0.79	Linseed oil	0.94
Alcohol, ethyl	0.79	Milk	1.03
Alcohol, methyl	0.81	Mineral oil	0.92
Ammonia	0.99	Muriatic acid	1.20
Benzoic Acid	1.27	Naphtha	0.76
Bromine	2.97	Nitric acid	1.50
Carbolic acid	0.96	Oleic acid	0.90
Carbonic acid	0.92	Petroleum oil	0.82
Carbon disulfide	1.26	Phosphoric acid	1.78
Carbon tetrachloride	1.60	Sulfuric acid	1.84
Chlorine	1.56	Tar	1.00
Ether	0.73	Turpentine oil	0.87
Gasoline	0.70	Vinegar	1.08
Glycerine	1.26	Water	1.00
Hydrochloric acid (conc)	1.19	Water, sea	1.03

sure is used. This approach will always show a valve size that is adequate for the greatest flow at minimum pressure drop.

Rangeability

Most of the curves showing the relationship between flow rate and per cent open, illustrated in the early part of this article, will show a positive, although small, flow at closed position. This is particularly true of the globe valve using V ports or a parabolic plug. This type of valve is used in a large percentage of control jobs. Constructional features necessitate designing for some appreciable minimum flow. A majority of these valves will operate with a minimum flow of 1/50 of the maximum flow or a rangeability of 50:1. Various designs will have valves of rangeability down to a generally accepted value of 15:1 for an unlined butterfly valve.

It becomes important in selecting a valve to determine whether or not the valve will control under the so-called maximum and minimum conditions. As stated before, the maximum condition is the maximum flow at minimum pressure drop, and the minimum flow is the minimum flow at maximum pressure drop.

Rangeability for liquid flow follows the relationship:

$$R_v = R_f\,(R_{dp})^{0.5}$$

Where:

$$R_f = \frac{\text{maximum flow rate}}{\text{minimum flow rate}}$$

$$P_{dp} = \frac{\text{maximum pressure drop}}{\text{minimum pressure drop}}$$

$$R_v = \frac{\text{maximum } C_v}{\text{minimum } C_v}$$

In this case the C_v factor is the calculated value and not the C_v of the nominal sized valve selected.

Example:

Maximum flow rate = 120 gpm at 5 psi drop
Minimum flow rate = 20 gpm at 20 psi drop
Product is water

$$R_f = \frac{120}{20} = 6$$

$$R_{dp} = \frac{20}{5} = 4$$

$$R_v = 6(4)^{0.5} = 12$$

C_v for maximum flow would be:

$$C_v = \frac{120(1.0)^{0.5}}{(5)^{0.5}} = 53.5$$

This C_v value would indicate a $2\frac{1}{2}$ in. valve with a C_v of 75. The maximum flow would require:

$$\frac{(53.2)^2}{(75)^2} = (0.713)^2 = 0.52 \text{ or } 52 \text{ per cent}$$

This would be the full flow of the valve. Assuming a valve with a minimum controllable flow of 2 per cent and this maximum required flow of 52 per cent, the rangeability of $52 \div 2$ or 26 is available while 12 is required. Assuming the desirability of a butterfly valve, a $1\frac{1}{2}$ size with a C_v of 56 would handle the maximum flow. The maximum flow required would be $(53.5 \div 56)^2$ or 97.7 per cent of the capacity.

Assuming a minimum controllable flow of 7 per cent for this type of valve, the rangeability would become $97.7 \div 7$ or 14, which is still acceptable.

As a summary for use in selecting a valve for a service, the following considerations are listed in the form of questions.

- What size of valve body is needed?
- What end connections are called for in the piping specifications for this pressure, temperature, and service?
- What body metal and rating should be used?
- Does chemical reaction exist, requiring lining with rubber, glass or saran? If so, may the body selected be lined?
- Does the service warrant using trim other than bronze, steel, or stainless steel?
- Does the service warrant consideration of one of the specially designed bodies?
- Are the stem guides adequate for the valve design and service?
- Are the valve parts readily replaceable?
- Are the packing and the method of duplication suitable to the service?
- Is the service such that a packless type of valve should be used?
- Are diaphragms or piston rings subjected to chemical reaction which require special consideration?
- Are the valves designed for lubrication under operating conditions? If so, is the type of body selected suitable for high temperature?
- Is there possibility of the valve being subjected to fire so that consideration of steel topworks or a valve, which will maintain a *status quo* may be advisable?
- Is a valve with a position indicator advisable?
- Do any of the reasons for reduced trim apply?
- Is positive lock-up required? If not, what leakage is tolerable?

Reference Data

TABLE 6 — OPERATING CHARACTERISTICS VS TYPE OF CONTROL

		See figure	1 72	2 67	3 73	4	5 127	6 128	7	8	9	10	11 130	12 131	13 136	14 137	15 138	16	17
Accuracy of control	± ½ per cent							X	X	X	X				X	X	X	X	X
	± 1 per cent					X	X					X	X	X					
	± 5 per cent		X		X														
	± 10 per cent			X															
Pilot bleed	To outlet line					X		X		X		X	X	X	X			X	X
	To atmosphere						X		X		X					X	X		
Inlet pressure failure	Regulator fails wide open		X	X	X		X	X	X	X		X		X	X	X		X	
	Regulator closes					X					X		X				X		X
Main diaphragm ruptures	Regulator fails wide open		X	X	X	X	X		X	X		X				X		X	
	Regulator closes							X			X		X				X		X
	Regulator takes control at lower outlet pressure													X	X				
Pilot control valve plugs	Regulator fails wide open						X		X	X	X		X						
	Regulator closes					X		X				X							
	Regulator takes control at lower outlet pressure													X	X				
Pilot control valve unable to close	Regulator fails wide open					X						X							
	Regulator closes									X	X		X						
	Regulator takes control at increased outlet pressure						X	X	X					X	X				
Pilot control diaphragm ruptures	Regulator fails wide open									X	X	X	X						
	Regulator takes control at increased outlet pressure						X	X	X					X	X				
Pilot bleed orifice plugs	Regulator fails wide open					X						X							
	Regulator closes									X	X		X						
	Regulator continues almost normal operation						X	X	X					X	X				
Instrument supply pressure fails	Regulator fails wide open															X		X	
	Regulator closes																X		X
Instrument bleed orifice plugs	Regulator fails wide open																X		X
	Regulator closes															X		X	

Column reference

1. Dead weight loading
2. Spring loading
3. Lever and weight loading
4. Pilot regulating — construction pressure — balance loading — reverse acting — no spring
5. Pilot regulating — construction pressure — balance loading — reverse acting — spring with
6. Pilot regulating — variable pressure — balance loading — reversed acting — spring operating
7. Pilot regulating — variable pressure — balance loading — reversed acting — spring with
8. Pilot regulating — variable pressure — balance loading — direct acting — spring operating
9. Pilot regulating — variable pressure — balance loading — direct acting — spring with
10. Pilot regulating — variable pressure loading — direct acting
11. Pilot regulating — variable pressure loading — reversed acting
12. Combination lever weight pilot regulating — construction pressure balance loading — reversed acting
13. Combination lever weight pilot regulating — variable pressure balance loading — reversed acting
14. Instrument controller variable pressure loading — atmospheric bleed — direct acting
15. Instrument controller variable pressure loading — atmospheric bleed — reversed acting
16. Instrument controller — variable pressure balance loading — outlet line bleed — direct acting
17. Instrument controller — variable pressure balance loading — outlet line bleed — reversed acting

Can be and is being successfully used

Should not be used

Proceed with caution. Used where corrosion is permissible

Information lacking

Selection of the metal employed in the valve body and trim must be made upon the basis of the specifications for the piping at the point of installation of the valve. Metals suitable for different services are shown in the charts on the following two pages.

These data should be studied carefully before a selection of metal is made. Particular attention must be made of the reference notes.

Reference Notes

(1) Severe corrosion sometimes experienced at locations where liquid changes to vapor and vice-versa.

(2) Iron and steel used, but combinations that produce sparks should be avoided at valve seats. High copper alloys prohibited by codes. Yellow brass acceptable.

(3) These recommendations apply to the industrial use of ammonia gas and to low temperature stages of its manufacture. They do not all apply to the handling of hot gases in its manufacture by the synthetic process.

(4) Iron and steel used. Some trouble experienced with hot solutions, especially adjacent to welds. Wherever possible welds should be stress relieved. Stainless steel first choice.

(5) Iron and steel used for handling beer in the Alcohol Industry but not permissible in the Beverage Industry.

(6) Recommendations do not apply to handling of these compounds at high temperatures. Behaviour when hot depends largely on amount and nature of impurities. See Note under "Hydrogen Sulfide and Organic Sulfur Compounds." Also see Note 16.

(7) Commonly encountered as pulping liquor in the pulp and paper industry. Copper and brass have been used in past and can be used again in emergency. Stainless steel (Type 316 or 317) preferred. Bronze valves should be trimmed with stainless steel.

(8) Iron and steel used for refrigerating brines. Severe corrosion indicates need for control of solution.

(9) These recommendations are based on industrial uses of the solvent. Galvanized steel commonly used for tanks and piping. Iron and steel are widely used in manufacture of solvent, with good success.

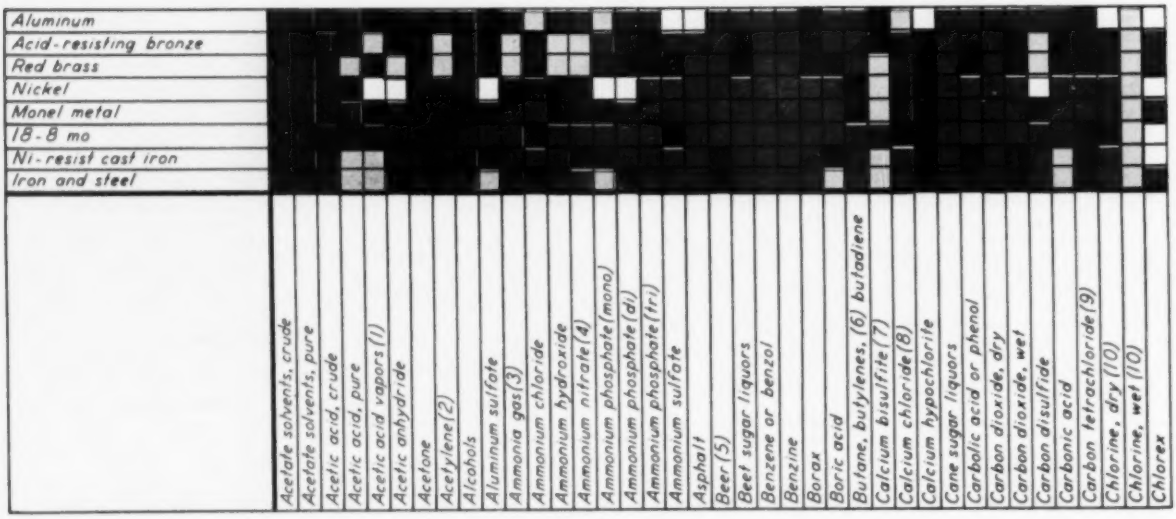
(10) Industrial applications of *dry* chlorine frequently involve locations where moisture is present. Steel gives good results as piping material but something better is needed for critical parts. Steel valves trimmed with monel or Hastelloy C give good results. Non-metals required for wet gas and aqueous solutions.

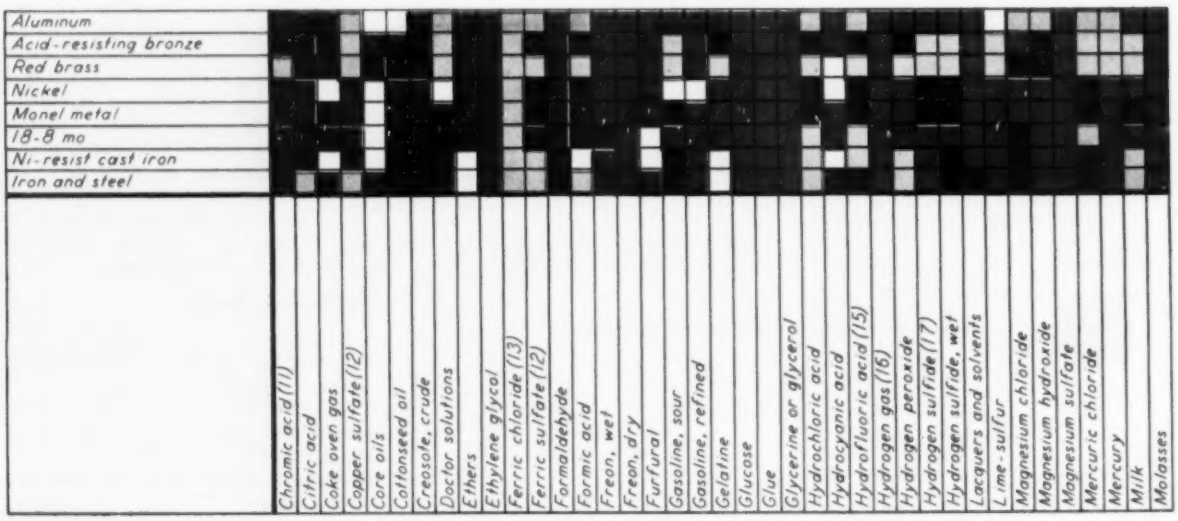
(11) Steel, with or without lead lining, used for tanks and piping. Corrosion of unlined steel adjacent to welds is common. Wherever possible welds should be stress-relieved if steel is not to be lined. Impingement by rapidly moving solution—especially when hot—may cause severe corrosion.

(12) See "Water, Acid Mine." Presence of copper sulfate and/or ferric sulfate in dilute sulfuric acid inhibits the attack of this acid on stainless steel.

(13) Non-metals usually indicated. Hastelloy C used with some success.

(14) Non-metals usually indicated. Hastelloys used with excellent results. Hastelloy B used as trim in steel valves in hydrochloric alkylation. Red brass or bronze valves with nickel alloy trim work well with dilute solutions (1 per cent). Do not use Hastelloys





with acid that has previously been in contact with copper alloys and has become contaminated with copper salts.

(15) Steel standard for piping in hydrofluoric acid manufacture and in hydrofluoric alkylation. Steel valves should be trimmed with monel metal or Hastelloy B.

(16) Recommendations apply to gas when used at ordinary temperatures. Extreme care should be exercised when the gas is to be handled at elevated temperatures, as in hydrogeneration and dehydrogeneration process.

(17) Recommendations apply to dry gas at ordinary temperatures. Nickel alloys very susceptible at elevated temperatures.

(18) Commonly encountered as constituents of nickel plating solutions, when equipment should be lead, lead-lined, Duriron, or rubber-lined.

(19) Straight chromium alloys used in preference to chromium-nickel alloys when feasible.

(20) Special high chromium-nickel alloys required.

(21) Includes Black, Green, and White Liquors encountered in Kraft paper mills. Iron and steel used for general piping. Low nickel (1-2 per cent) cast iron much superior to nickel-free cast iron and widely used for valve bodies and fittings. Stainless steel used for valve trim. Evaporator tubes may require special alloys.

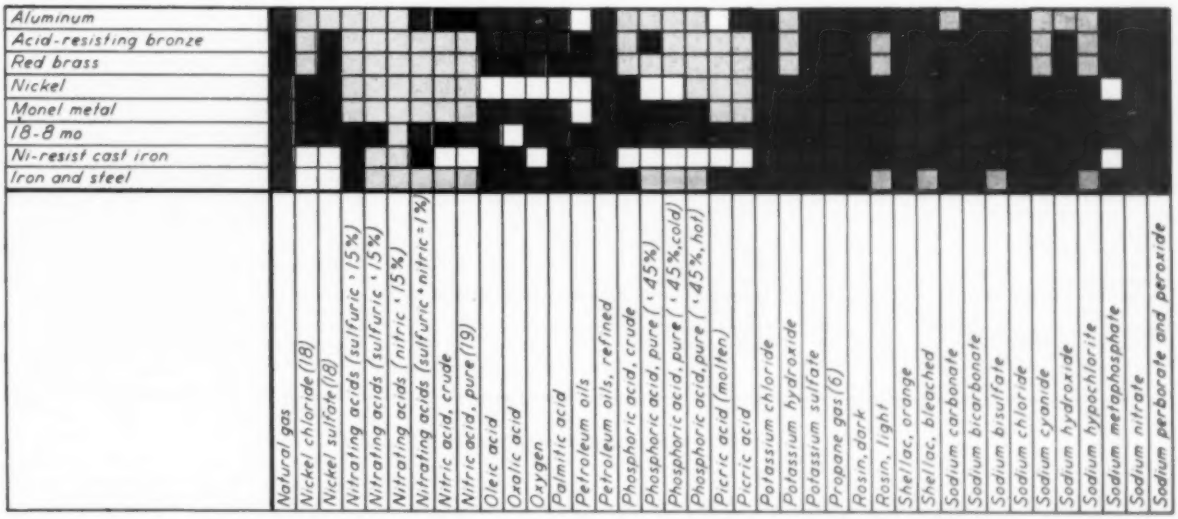
(22) When gas is wet apply recommendations for "Sulfurous Acid."

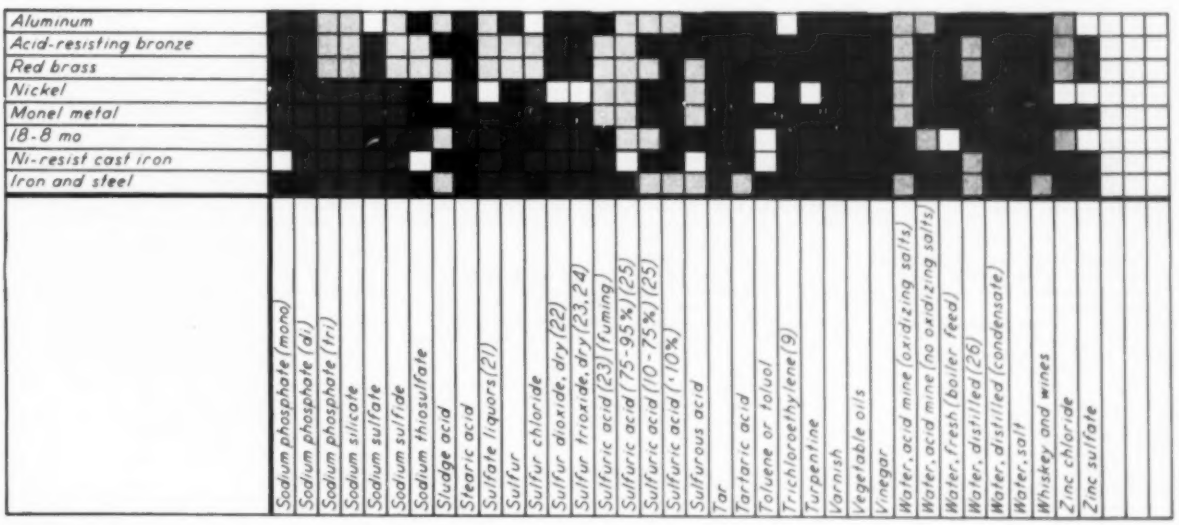
(23) When gas is wet apply recommendations for "Sulfuric Acid" (10 per cent).

(24) Sulfur trioxide, either as a constituent of fuming sulfuric acid or when being handled as a gas, is capable of penetrating cast iron along the grain boundaries and causing intergranular cracking. Much cast iron equipment is used, but safety considerations suggest that steel should be used wherever possible.

(25) Special high chromium-nickel alloys having good resistance to a wide range of concentrations are being used. Ordinary iron and steel good where concentration remains over 90 per cent. Absorption of moisture from the air dilutes exposed acid and makes it more corrosive to iron.

(26) Current practice in many cases where a mineral free water is required is to use the effluent from a softener employing "hydrogen" zeolites. Such water may be distinctly "acid" and correspondingly corrosive. Final application may require that it be handled in rubber lined pipe or in piping made of stainless steel and monel metal.





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Some Engineering Considerations in the

Application of Spreader Stokers

E. C. MILLER, *Research Engineer*
Riley Stoker Corporation

THE GENERAL SUBJECT of spreader stokers is so vast that in order to get a comprehensive discussion within the allotted space only a few of the most important design considerations in the application of spreader stokers can be included here. Ample general information on spreader stokers has been published over the years; therefore, a preliminary discussion of the principles of spreader stoker firing will be eliminated.

Spreader stokers cover the field that was dominated at one time by underfeed stokers. The stationary or dumping grate is used where formerly single retorts or small multiple retorts were used, and the traveling grate spreader stoker is used in place of the large multiple retort stokers. Dumping grate capacities range up to 100,000 lb of steam per hr, but most of the units are in the 10,000 to 30,000 lb per hr size range. Traveling grate spreader stokers are built in sizes from 15,000 to 400,000 lb per hr with a 30,000 to 175,000 lb of steam per hr range representing most of the applications.

Selection of spreader stokers in place of underfeeds has been publicized widely because the lower quality of bituminous coals can be burned more effectively and efficiently by spreaders than by underfeeds. The very pronounced advantage of the spreader stoker in this respect shows up to the greatest degree at high burning rates. It is quite well known that high burning rates can be obtained easily with spreader stokers whereas forcing of underfeeds creates a problem in carbon loss, stoker maintenance and clinkering.

Although spreader stokers are more versatile than underfeeds from the standpoint of fuel selection, there are certain problems in any type of stoker firing which tend to limit the size of stoker fired units. It is not likely, for the present, that many spreader stoker units in excess of 250,000 lb of steam per hr will be installed for burning coal because certain handicaps, present in underfeed firing and remaining in spreader stoker firing, give pulverizers an advantage in large units. The practical top size of spreader stoker fired units increases as fuel quality and grindability decreases.

Selection of firing equipment for bituminous coal for sizes of 10,000 to 200,000 lb per hr should include a careful analysis of the spreader stoker. At the smaller end of the range, it can be assumed that the dumping grate spreader will be most favorable. However, there is a growing interest in small traveling grate stokers for installations where small capacities of high ash coal are burned continuously.

A few years ago dumping grate stokers up to 100,000 lb per hr were being promoted but these have pretty much passed from the picture. Fig. 1 illustrates a dumping grate unit. An important consideration of the dumping grate is the ash pit, for high continuous ratings depend upon the time required for ash removal. The ash pit shown in the illustration is a desirable type if full load must be carried during the cleaning period.

Traveling grate spreader stokers have an advantage over pulverizers

TABLE 1—RECOMMENDED GRATE HEAT RELEASE RATES

Btu in fuel per hr per sq ft of grate area

Continuous boiler capacity, lb per hr	100,000	200,000	300,000
Release rate for maximum continuous load	650,000	700,000	725,000
Release rate for 2 hr peak loads	725,000	775,000	800,000

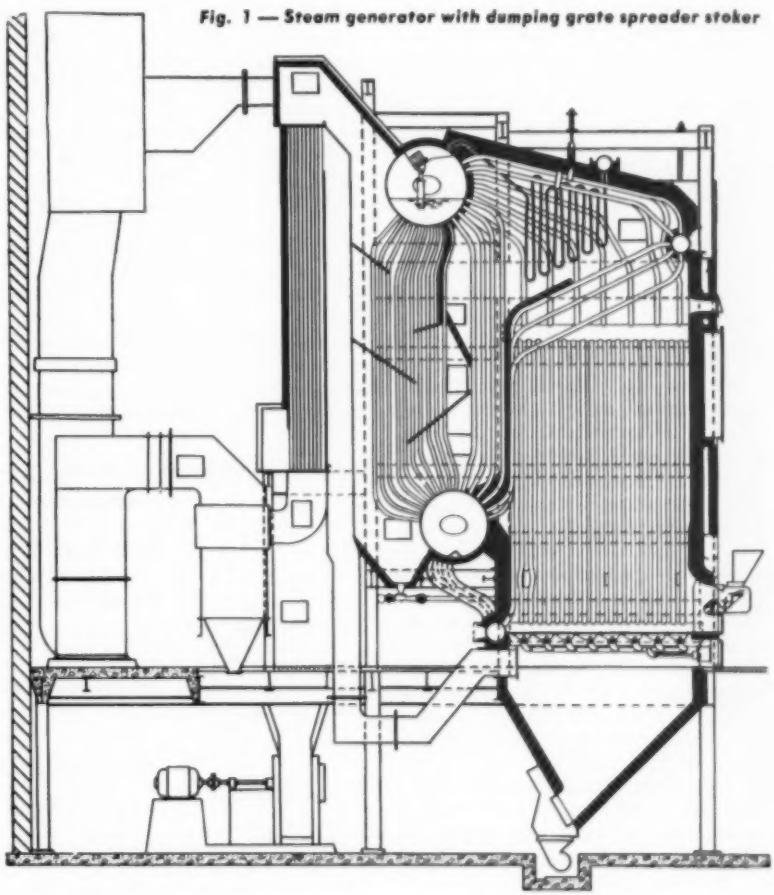


Fig. 1 — Steam generator with dumping grate spreader stoker

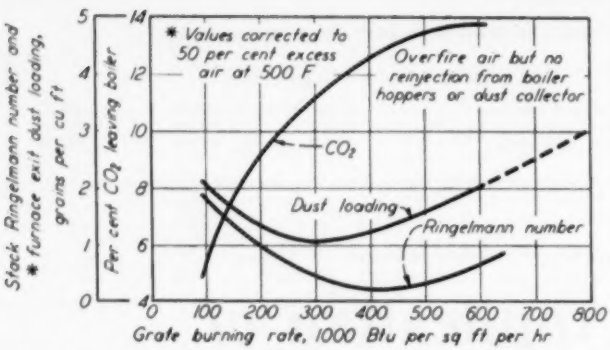

* Values corrected to 50 per cent excess air at 500 F
Overfire air but no reinjection from boiler hoppers or dust collector
CO2
Dust loading
Ringelmann number
Stack Ringelmann number and * furnace exit dust loading, grains per cu ft
Per cent CO2 leaving boiler
Grate burning rate, 1000 Btu per sq ft per hr

Fig. 2 — Low load performance of spreader stoker fired boilers

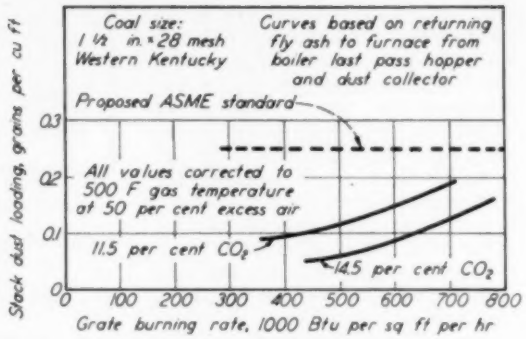

Coal size: 1 1/2 in. x 28 mesh Western Kentucky
Curves based on returning fly ash to furnace from boiler last pass hopper and dust collector
Proposed ASME standard
All values corrected to 500 F gas temperature at 50 per cent excess air
11.5 per cent CO2
14.5 per cent CO2
Stack dust loading, grains per cu ft
Grate burning rate, 1000 Btu per sq ft per hr

Fig. 3 — Stack dust loading for spreader stoker firing

in cost of installation for a capacity range of 50,000 to 150,000 lb per hr. This advantage is frequently great enough to offset any advantage that might be shown in the performance of pulverizers. Floor space, bunker design, and other factors common to large stokers must be considered more carefully as the stoker size increases.

Design Considerations

Engineering problems encountered when designing spreader stokers are essentially the same in new or rebuilt units. Some of the most important considerations are in the selection of grate size, furnace design, preheated air, load range, dust loading in the boiler, and dust emission from the stacks. These factors, of course, are interconnected and have various ramifications. It is sometimes difficult to separate these different factors for occasionally deficiency in one will react unfavorably in another. To get optimum performance from the spreader stoker, each and every one of the factors in the entire unit must be given consideration.

Selection of Grate Size

One very controversial point in the engineering of spreader stokers is the selection of grate size or, in other words, the establishment of grate burning rates. Proponents of low burning rates point to the fact that gas velocity increases in proportion to the burning rate and, therefore, a larger percentage of solids are retained in suspension and pass through the boiler as cinders. This causes very high dust loadings which adversely affect performance and boiler maintenance. Proponents of very high burning rates point to the fact that over-all performance is better throughout the entire load range. Usually, the factor of high dust loading is disregarded and emphasis is placed on the poor performance of spreader stokers at low burning rates. The vast majority of available data indicates both of the adverse factors are present. A penalty in low load performance must be paid if burning rates are too low, and the adverse effects of high dust loading will be present if burning rates are excessively high. While it is quite true that fly ash loading can be reduced by properly designed reinjection and overfire air systems and low load performance can be improved by zoning and good distribution, the fact remains that these are two critical points which require attention.

Very reliably established data (1) accumulated by the industry and presented in Fig. 2 shows that dust loading increases with burning rate and improved performance at the extreme ends of the operating range would be highly desirable. There is no indication at present that Stokes' law of terminal velocities can be ignored completely in a spreader stoker furnace. As vertical velocities through the grate and furnace increase, greater amounts of solids will be entrained. Irrespective of other improvements that are possible, such as properly designed overfire air and reinjection systems, this basic law remains. A recent series of tests (2) revealed that very low dust emission is possible with complete reinjection but, as shown in Fig. 3, dust loading still increases at high burning rates. Most of the Eastern coals require total reinjection from the dust collector to prevent high carbon loss. This is not the case with some Midwestern coals or lignite.

It is very important that low load operation be improved, and steps are being taken in that direction. Most particularly, it appears that improvement of CO_2 and reduction of smoke at low loads are only parts of a common problem and should be solved without resorting to excessively high burning rates (3).

Recommended Burning Rates

Standards for burning rates should be selected to assure safe dust loading in the boiler and at the same time provide a wide range of highly efficient spreader stoker operation. The best spreader stoker performance is obtained with burning rates of 250,000 to 600,000 Btu per sq ft per hr, efficiency being nearly constant throughout this range. This fact together with the load factor must be combined to arrive at proper grate size, and Table 1 has been included to indicate typical release rates that are now being used.

Furnace performance with spreader

TABLE 2—RECOMMENDED FURNACE HEAT RELEASE RATES

Btu in fuel per hr per cu ft of furnace volume

Load	Refractory furnace	Water cooled furnace
For Iowa coal, subbituminous coal and lignite		
Recommended continuous	25,000	22,000
Maximum continuous	25,000	25,000
Two hour peak	35,000	35,000
For bituminous coals other than shown above		
Recommended continuous	30,000	25,000
Maximum continuous	30,000	30,000
Two hour peak	35,000	40,000

Recommended minimum furnace height in feet

Type of coal	HRT boiler	Refractory furnace	Water cooled furnace
Eastern	6	10	12
Midwestern	6	10	14
Lignite	7	12	15

stoker firing is known to be quite different from that encountered with pulverized coal or underfeed stoker firing. Some basic data on spreader stoker furnace performance has been obtained by an ASME sponsored research program (2 & 4). This information indicates the best spreader stoker operation is obtained with a liberal furnace design, and the standards for heat release listed in Table 2 have given satisfactory performance.

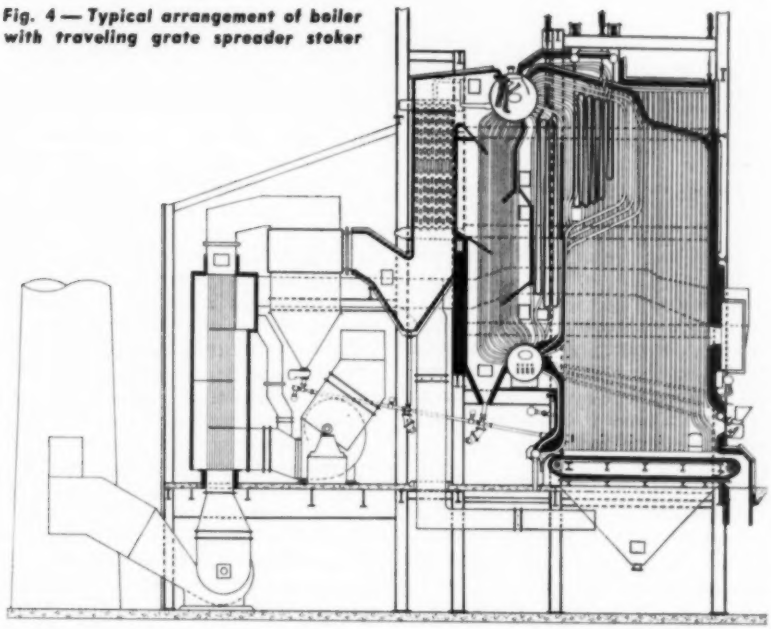
Design of the furnace should be such that it provides ample volume for combustion, adequate protection of the refractory by water cooling of the walls, and sufficient cross-sectional area to assure low velocity. High velocities within the furnace will necessarily carry out larger particles and greater quantities of solids. Even with proper furnace turbulence and reinjection arrangements, high vertical velocities in furnaces will result in correspondingly high dust loading in the exit gases. Fig. 3 shows that total dust increases when the excess air or burning rate increases. This performance is based on units of the type shown in Fig. 4.

Additional factors in furnace design include the water cooling. There is some opposition to complete water cooling because of the very low furnace temperatures that are experienced at low loads. Again the question of low load operation of spreader stokers must be considered. It has been the practice to improve low load operation by covering the water walls with refractory. This is undesirable for ultimately the refractory will cause trouble when higher loads are carried. Low load operation should be improved without sacrificing water cooling.

Furnace temperature is influenced by excess air as well as the water cooling. It can be shown that, at a release of 40,000 Btu per hr per sq ft of wall surface, a reduction from 125 to 80 per cent excess air will increase the furnace temperature by 160 F. Yet, for the same release, if 50 per cent of the water cooling was eliminated completely and 125 per cent excess air was retained, the furnace temperature would be increased only 100 F.

Water cooling of furnaces is illustrated by Fig. 5. Complete water cooling as shown will assure a minimum of furnace maintenance and will permit long periods of satisfactory operation without the necessity of deslagging the furnace. The trend in some new jobs is to closer tube spacing than shown in the photograph. The lower rear wall required tangent tube spacing or heat resistant castings between tubes to prevent refractory erosion.

Fig. 4 — Typical arrangement of boiler with traveling grate spreader stoker



Effect of Preheated Air

There is scarcely an item of spreader stoker design that does not tie into low load performance. One factor that has a beneficial effect is the use of air preheaters, as raising the temperature of the incoming air effectively increases the temperature at the fuel bed. In fact, ample evidence indicates carbon content of the fly ash is materially lower in units equipped with air preheaters than it is on cold air installations. This reduction in fly ash carbon content in preheated air units is probably due to two factors. First, preheated air increases the temperature in the lower part of the furnace where the fly ash is introduced, thereby contributing to better burning of the cinder particles. Second, the conveying air also is preheated and therefore the cinder particles enter the furnace at higher temperatures than is the case in cold air units. This increase in both lower furnace and particle temperatures causes earlier and more complete burning of the cinder within the furnace.

Size Consist of Fuel

While the work of stoker and boiler designers plays an important part in the success of spreader stoker units, one factor is beyond their control. It is the fuel and this is important. There are many points in a complete fuel specification, but for the spreader stoker user one factor stands out above all others. It is size consist and, most particularly, uniformity of size consist.

Fuel sizing for spreader stokers has been the subject of considerable debate and discussion for a number of years. Most engineers agree that a very wide range of sizes can be handled effectively by spreader stokers, and also realize that size consist plays an important part in efficiency and performance. To put the industry on common footing, the AB&AI adopted standards of fuel sizes for spreader stokers which were agreeable to both equipment manufacturers and coal producers. These standard specifications were published in the 1947 AB&AI Manual which lists the following recommendations for fuel sizes:

Eastern bituminous coal (friable) —1¼ in. or 1½ in. nut and slack, not more than 50 per cent slack through ¼ in. round mesh screen.

Eastern bituminous coal (non-friable) and Midwestern bituminous coal —¾ in. nut and slack, not more than 50 per cent slack through ¼ in. round mesh screen.

These sizes are qualified by the notation: Fuel is to be delivered across stoker hopper without segregation.

Although sizing is based on both nut and slack, consideration also has been given to the structure of the coal. Limits have been put on top size because spreader stoker fuel beds must be kept thin. If the particles of coal are too large, they require such a long time to burn that they cause caking or clinkering and usually increase the ash pit carbon loss. If fuel is of low fusion temperature, large size particles materially increase the clinkering. Small size particles give very rapid re-

sponse in spreader stoker firing, but the per cent of very fine in fuel has been limited, because of two adverse effects. The most serious objection to an excessive percentage of fines is that such coal is extremely troublesome to handle and keep flowing when it is wet. Secondly, an increase in the percentage of fines in the coal will increase fly ash emission.

Generally, the hard structured Midwestern coals will give satisfactory performance in the furnace and will flow through the coal handling system if top size is held between ½ and 1 in. For hard structure Eastern coals, this limit can be increased from ½ to 1½ in., but on the very soft Eastern coals the top size usually should be kept above 1 in. to prevent excessive fly ash and to assure flow through the coal handling system. These variations in top size are due to the relationship between nut and slack. In most cases, it is the very fines that are to be limited, but unless the size consist is disrupted by screening or washing, there is a definite relationship between very fine and top size percentages for any given coal.

Table 3 presents size consist of three readily available fuels that are used in spreader stoker fired units. All of them are referred to as 1¼ x 0 in. and the per cent of 1 x 1¼ in. is nearly the same on the three. The big difference comes in the smallest sizes. Both the Ohio and Pittsburgh coals can stand crushing to ½ or ¾ in. without danger of producing too much slack, but the medium volatile West Virginia coal, if crushed, would have 85 per cent through the ¼ in. mesh for a top size of 1 in. This high percentage of fines would make handling of wet coal difficult and increase dust loading.

Coal washing procedures take out most of the fines under No. 60 mesh, and by elimination of these high ash particles, smaller nominal sizes can be used successfully. The following ⅜ x 0 in. wash screenings have less fines through the No. 16 and No. 60 mesh than does the 1¼ x 0 in. West Virginia medium volatile in Table 3. These screenings do not come within the AB&AI size standard but nevertheless are a satisfactory fuel.

Screen size	Per cent passed
1/2 in.	100.0
3/8 in.	86.9
1/4 in.	69.6
3/16 in.	58.3
1/8 in.	45.9
No. 16—.0469	25.0
No. 60—.0098	5.1

Although spreader stokers will handle a wider range of sizes than has been given here, this range gives considerable latitude in the selection of fuel and assures satisfactory handling and over-all performance.

Uniformity of Fuel Size

Unfortunately, the standard specifications do not include adequate information on the subject of uniformity. The statement "Fuel is to be delivered across the stoker hopper without segregation" appears almost as an afterthought. Much more attention is deserved. Segregation at the hopper is but one part of uniformity of size. Difficulties which would be experienced in maintaining good distribution on the grate with slack fed on one side of the furnace and nut on the other are obvious. The possibility of intolerable segregation increases with the width of the stoker. This is a factor long realized in underfeed and traveling grate firing.

Segregation in the bunker or even as far back as the unloading facilities can cause trouble. In fact, it can start in the coal supply, but usually this is the easiest source of trouble to correct. Many times coal suppliers provide uniform size consist only to have the uniformity lost in the coal handling and storage system.

The spreader stoker is a most important method of solid fuels firing in the intermediate size boilers. It has versatility in coal supply and is readily adaptable to dual firing with oil, gas or refuse fuels. The conservative design is recommended. Particular attention must be given to uniformity of coal size and prevention of segregation.

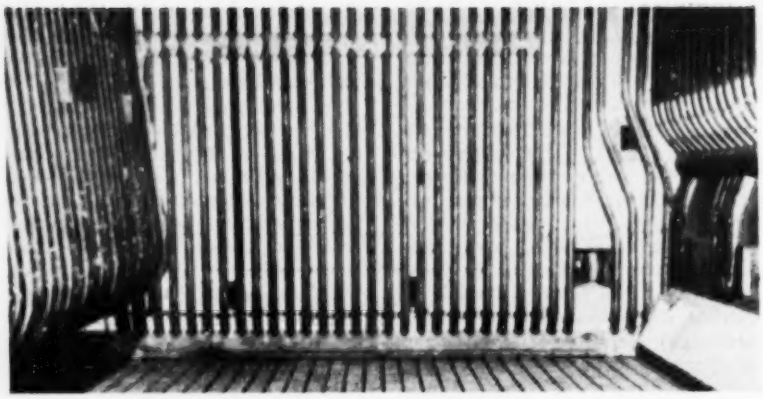


Fig. 5—Complete water cooling as shown above minimizes furnace maintenance

TABLE 3 — SIZE CONSIST OF TYPICAL SPREADER STOKER COALS

Type of coal	Screen size	Per cent retained	Per cent passed
Ohio strip mine	1 in.	2.4	97.6
36.0% volatile	¾ in.	8.7	88.9
14.1% ash	½ in.	29.6	59.3
12,540 Btu per lb	¼ in.	37.2	22.1
2190 F fusion	No. 16 — .0469	16.2	5.9
Pittsburgh	1 in.	2.99	97.01
37.0% volatile	¾ in.	21.68	75.33
8.7% ash	½ in.	22.78	52.55
12,750 Btu per lb	¼ in.	18.95	33.60
2300 F fusion	No. 16 — .0469	23.85	9.75
West Virginia	1 in.	2.73	97.27
27.4% volatile	¾ in.	3.45	93.82
7.1% ash	½ in.	7.82	86.00
14,060 Btu per lb	¼ in.	24.18	61.82
2375 F fusion	No. 16 — .0469	31.46	30.36
	No. 60 — .0098	21.36	9.00

Analyses are based on dry coal

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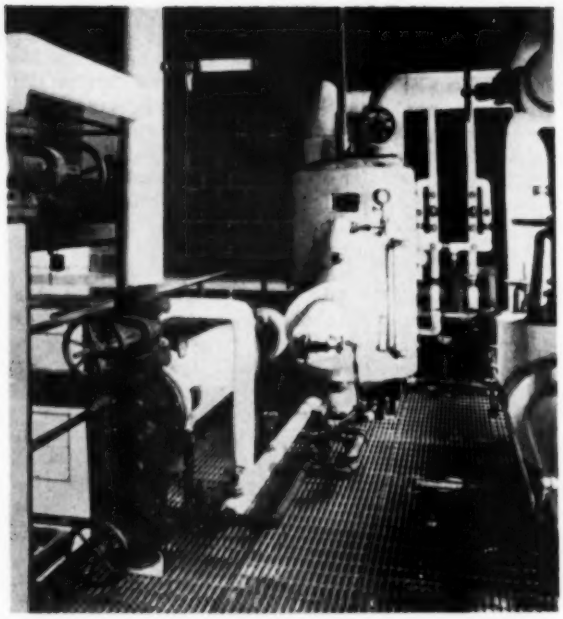

Continuous Blowdown Systems

In this article the author reviews the principal functions of continuous blowdown systems, details the multiple benefits they provide, and describes equipment arrangements for various applications

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Installation photograph shows general arrangement of flash tank-heat exchanger type blowdown system in packing plant

ONE of the most important considerations in the operation of any power plant is the maintenance of uniform total solids concentration in the boiler water. This fact has been well recognized for many years, and all power plant operators are familiar with the customary practice of blowing down boilers to remove dissolved and suspended material. In the past, this procedure usually consisted of periodically blowing off part of the boiler water, using the gage glass to indicate the amount removed. Since this blowoff is at the temperature and pressure of the boiler, it is obvious that this method wasted considerable heat. Furthermore, solids concentration varied from high to low points between each intermittent blow. This condition is illustrated graphically by Fig. 1.

When modern bent tube boilers were introduced, the practice of blowing down periodically became increasingly hazardous due to the small water capacity of these units. Smaller tube sizes and more intricate tube patterns forced greater emphasis on feedwater conditioning and caused boiler manufacturers to establish specific limits for total solids concentration at various operating pressures. Table 1 tabulates the limits as established by the American Boiler Manufacturing Association and Affiliated Industries. This in turn led to the development of the continuous blowdown process in which a relatively small quantity of water is removed from the boiler at all times.

Continuous blowdown systems offer multiple advantages. These advantages include the following:

1. Constant removal of dissolved and suspended material permits the maintenance of uniform concentration of boiler salines. This minimizes the danger of sludge accumulation and scale formation.

2. Smoother operating conditions foster the generation of cleaner steam since foaming is eliminated by maintaining proper saline concentration.

3. Heat in the blowdown water may be utilized for preheating feedwater or, under certain circumstances, for generating low pressure steam for hot process softeners or deaerating heaters.

4. Waste of boiler water is eliminated since the correct level of blowdown is maintained. Elimination of this waste naturally reduces makeup water quantity and hence feedwater treating requirements.

Selection of a continuous blowdown system for a particular plant will depend on many factors, such as boiler design, operating pressure, feedwater cycle and plant heat balance. Some of the earlier systems tried to utilize both the heat and chemical properties of the blowdown by returning the blow-

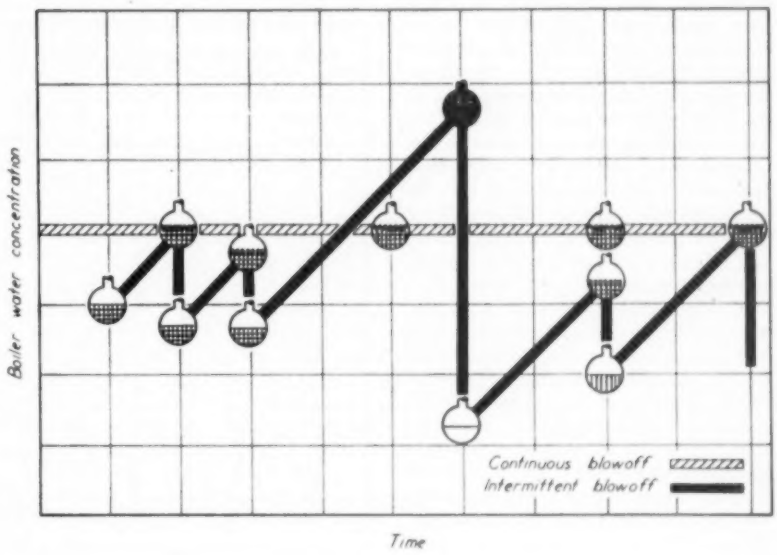
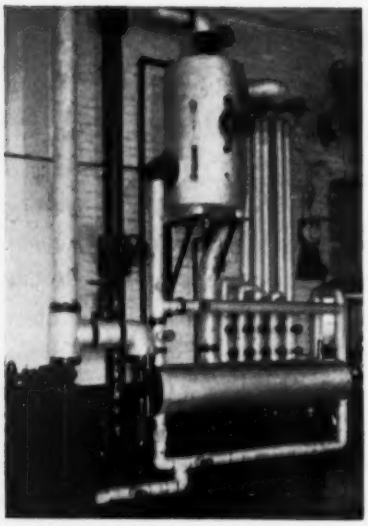


Fig. 1—Drawing illustrates contrasting effects of continuous and intermittent blowoff on boiler water concentration



Typical blowdown system includes flash tank, heat exchanger and control valves

down water to the hot process softener treating the feedwater. However, this arrangement proved unsatisfactory as it did not reduce the concentration of permanently soluble salts.

For most plants operating at moderate pressures, relatively simple continuous blowdown systems can be used. As plant pressures increase and heat balances become more complicated, systems naturally become more elaborate, but the general principle of heat recovery remains the same. In all cases, the only loss is the thermal difference between the blowoff discharged to waste and the incoming makeup water.

The simplest continuous blowdown systems utilize a heat exchanger in the makeup water line and include means for either manual or automatic flow regulation. Manual systems employ a flow control valve, which must be set manually to the correct position for the desired blowdown rate, on the downstream side of the heat exchanger. The operation may be made automatic by the installation of a thermostatically controlled valve instead of a flow control valve. This valve automatically proportions the amount of blowdown water to the amount of makeup water. In both the automatic and the manual systems, the control valve must be installed on the downstream side to prevent flashing in the heat exchanger.

In most plants, this system is modified by including a flash tank between the boiler and the inlet to the heat exchanger. Then concentrated boiler water enters a tank operated at any desired pressure, although usually this pressure corresponds to that of the operating pressure of the feedwater heater. Since the entering water is at boiler pressure, the reduction in the tank causes flashing and steam is generated at the lower pressure. Table 2 lists the quantity of steam flashed in percentage of blowoff. This steam can be used in the feedwater heater while the balance of the unflashed water passes through the heat exchanger and is cooled by the makeup water.

On installations where there is a need for steam at a pressure intermediate between boiler and exhaust steam pressure, the continuous blowdown system can be modified to include two flash tanks between the boiler and one or more heat exchangers. In this case the high pressure flash tank develops flash steam for use at the intermediate pressure, the low pressure flash tank passes steam to the feedwater heater, and the remaining hot liquid again is used to preheat incoming makeup water. Further modifications are possible, such as installing a high pressure exchanger in the boiler feed line between the two flash tanks.

Another relatively simple arrangement employs a combination of high pressure and low pressure heat exchangers, in which blowdown water first passes through a high pressure exchanger located in the feed line between the pump discharge and the boiler before passing to a low pressure exchanger. With this system the low pressure exchanger again must be controlled either manually or automatically from the waste water outlet temperature to prevent flashing or water hammer. This type of layout is useful in plants where the makeup is such a small percentage of the total feed that it could not absorb all of the available heat in the boiler blowoff.

Under certain conditions, the total recoverable heat from the blowoff plus the available exhaust steam may be in excess of that required to heat the feedwater to steam temperature in an open or deaerating heater. In such case, many plants add a flash condenser to the usual flash tank-heat exchanger system to prevent possible wastage. In this arrangement, steam from the flash tank passes to a flash condenser located in the feed line to the boiler thereby raising the temperature of the feedwater above that leaving the deaerating heater. The flash condenser in turn discharges back to the deaerating heater while liquid from the flash tank passes through the heat exchanger with makeup water as the cooling medium.

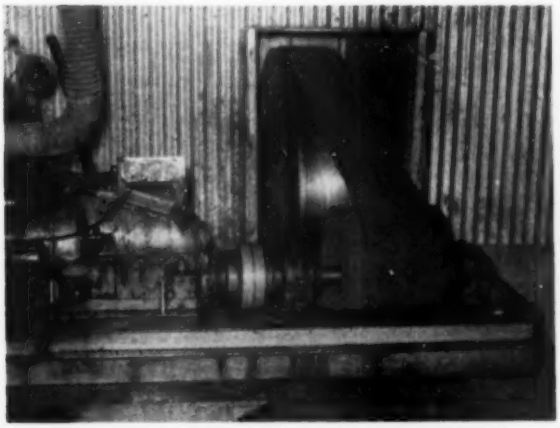
As previously mentioned, the exact arrangement and number of flash tanks and heat exchangers must be determined from the individual plant heat balance. In most cases, a properly designed blowdown system will return the initial investment within two years under normal operating conditions on a basis of heat recovery alone. In addition, less tangible benefits in the form of more satisfactory boiler performance, more accurate feedwater treatment control, and less operating difficulties will be achieved.

TABLE 1 — CONCENTRATION LIMITS

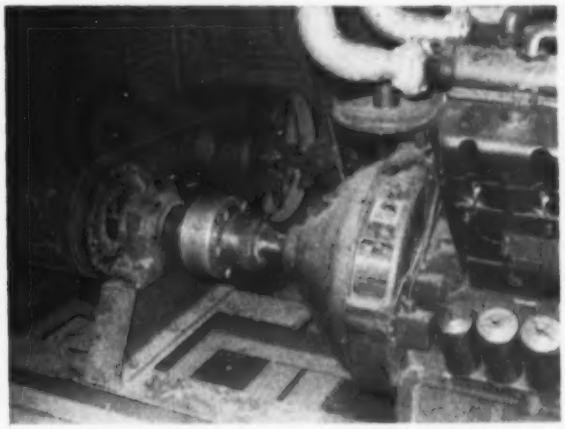
Boiler pressure psig	Total solids ppm
0-300	3500
301-450	3000
451-600	2500
601-750	2000
751-900	1500
901-1000	1250
1001-1500	1000

TABLE 2— STEAM FLASHED IN PERCENTAGE OF BLOWOFF FOR VARIOUS BOILER PRESSURES

Boiler pressure psig	Flash tank pressure, psig												
	0	5	10	20	30	40	50	75	100	125	150	175	200
	Steam flashed, per cent												
50	9	8	6	4	3	2	0	0	0	0	0	0	0
75	11	10	8	6	5	4	2	0	0	0	0	0	0
100	13	12	10	8	7	6	4	2	0	0	0	0	0
125	15	14	12	10	8	7	6	4	2	0	0	0	0
150	17	15	13	12	10	9	8	6	4	2	0	0	0
200	19	18	16	14	13	12	11	8	6	4	3	2	0
250	21	20	18	16	15	14	13	10	8	7	5	4	3
300	23	22	20	18	17	16	14	12	10	8	7	5	4
350	24	23	22	20	18	17	16	14	12	10	8	7	6
400	26	25	23	22	20	19	18	15	14	12	10	9	8
450	27	26	24	23	21	20	19	16	15	14	12	10	9
500	28	27	26	24	23	22	21	18	17	15	14	13	11
600	31	29	28	27	25	24	23	20	19	17	16	14	13
700	33	31	30	29	27	26	25	23	22	20	18	17	16
800	34	33	32	31	29	28	27	25	24	22	20	19	18
900	36	35	34	33	31	30	29	26	25	24	22	21	20
1000	38	37	35	34	33	32	31	28	27	26	24	23	22
1200	41	40	38	37	36	35	34	32	30	29	27	26	25
1400	44	43	42	40	39	38	37	35	33	32	31	29	28
1600	46	45	44	43	42	41	39	38	36	35	34	32	31



Relatively short center distance and great differential in pulley diameters called for mounting on tension base



Because of space limitations, the center distance of this drive is only 48 in. Belt is 16 in. wide, 3-ply

How to Apply Belting for Cotton Gins

FRANCIS A. WESTBROOK

COTTON GIN drives have characteristics, which must be met adequately, if operation is to be satisfactory. For example, the load of a four stand gin is fairly steady until a bale is ginned, then the press goes up and the loose cotton is baled and bagged. At that time the load increases from 100 to 115 and 125 hp. This peak is generally reached four times per hour with a four stand gin, which produces four bales per hour. Gins usually have from three to six stands, and as a stand produces about one bale per hour the number of peak loads in that period usually equals the number of stands. In other words the drive must be designed for from three to six peaks per hour. This exceeds the normal load between times by from 15 to 25 per cent.

In addition to these sudden peak loads there are a number of operating conditions, which must be met by the drives. For example, the drive location is often hot and dusty, and the center distances may have to be short because of space limitations. Although all cotton gin drives must meet these conditions there is usually more than one way of accomplishing this. As operation of these ginning plants is seasonal, keeping the investment as low as possible is particularly desirable.

Gas engine power with flat leather belt transmissions is frequently used. An example of this is found at the six stand Gullett gin at the Sidney Bertheaud operation in Opelousa, La. Power is provided by a 12 cylinder, 800 rpm gas engine equipped with a 24 in. diam driving pulley. The lineshaft pulley is 48 in. in diam with a 10 cc. Transmission is by means of an 18 in. wide four-ply flat leather belt. The belt speed is about 5000 fpm.

This 12 cylinder engine was installed to take care of future expansion, and the drive is of sufficient capacity to handle the added load when cleaning equipment is installed for machine picked cotton. Drive performance has been completely satisfactory, and peak loads have been handled well. An idler pulley was included.

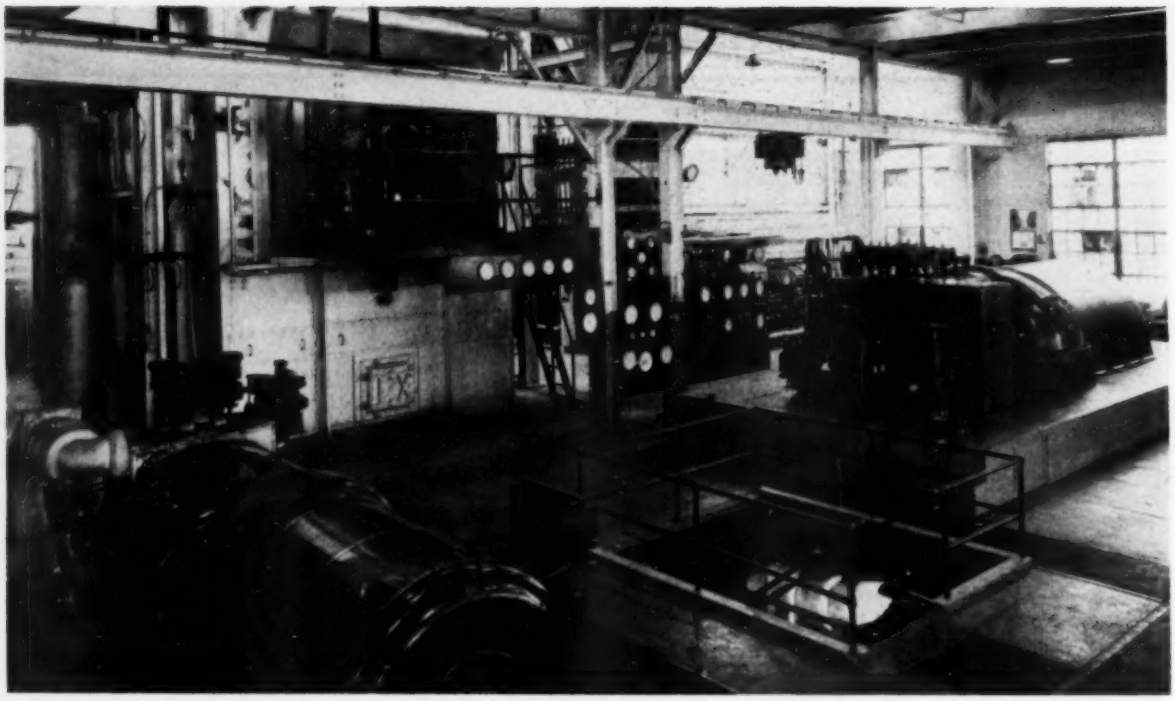
The Prarig Ronde Gin Co., also of Opelousa, La., has a five stand gin with a 6 cylinder marine diesel engine, with reduction gear mounted on a tension control base. A 20 in. diam engine pulley is used with a 72 in. diam lineshaft pulley. The distance between centers is 80 in. This relatively short center distance and the big difference between pulley diameters called for mounting the engine on a tension control base. Transmission of power is by flat leather belt.

Atmospheric conditions are very hot and dusty in this location, but the installation has operated successfully for three seasons. The engine is heavily loaded, but it handled the peaks well because the tension control base permits the belt to take them easily and readjust to normal load.

Another installation includes an 8 cylinder butane engine driving a 4 stand Gullett gin. The engine pulley diameter is 17 in. and the driven pulley on the lineshaft 34 in. in diam. Because of limited space calling for a compact drive the center distance between these pulleys is only 48 in. The transmission belt is 16 in. wide and three-ply.

The manager of this operation wanted a drive that would carry the load without slip, and also with reserve capacity that will enable him to add to the load when the machine picked cotton comes into his territory. The maintenance men who look after this installation say that the drive is performing in a very satisfactory manner, in spite of the fact that the engine is not mounted on a tension control base for such a short center distance.

A 5 stand Maurray gin, equipped to handle mechanically picked cotton is powered by an engine operating at approximately 1140 rpm and drives the lineshaft at 700 rpm. Power transmission from engine to line shaft is by chain with single $1\frac{1}{2}$ by 4 sprockets with hardened teeth. The driving sprocket has 29 teeth and the sprocket on the lineshaft 48. The total length of the chain is 9 ft, and it operates in an oil tight casing.

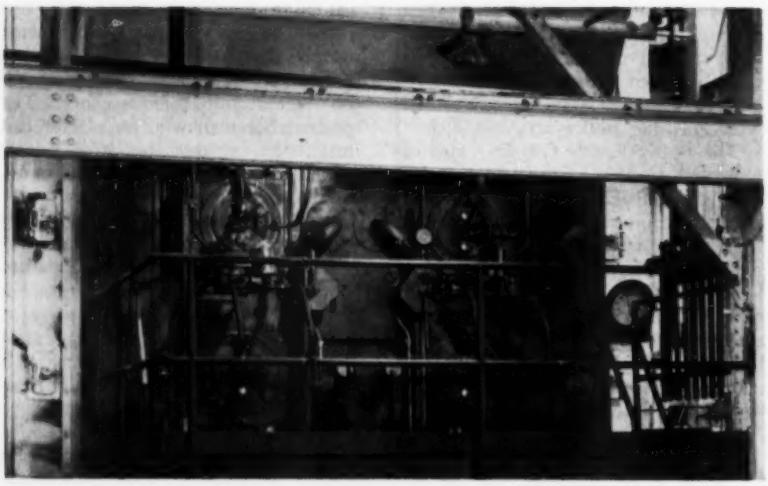


This clean plant has combination gas-oil fired boilers and power generating equipment installed in the same area

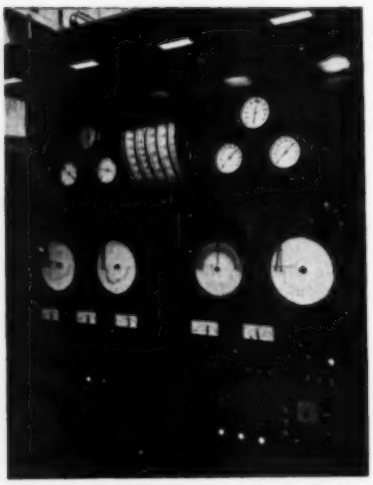
Automatic Combustion Control for Gas Burners

WILLIAM H. PUGSLEY
Vice President in Charge of Field Research
The Hays Corporation

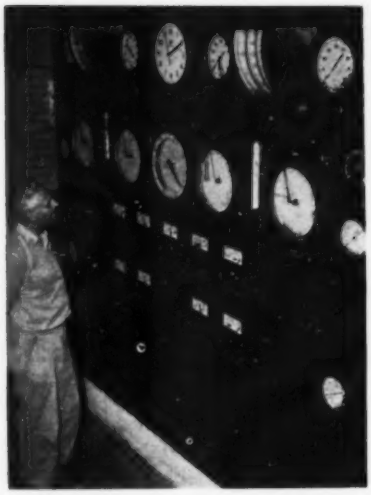
Natural gas possesses favorable qualities that are not found in other conventional fuels. It is extremely suitable for use with combustion control systems and provides many plants with clean, economical operating conditions



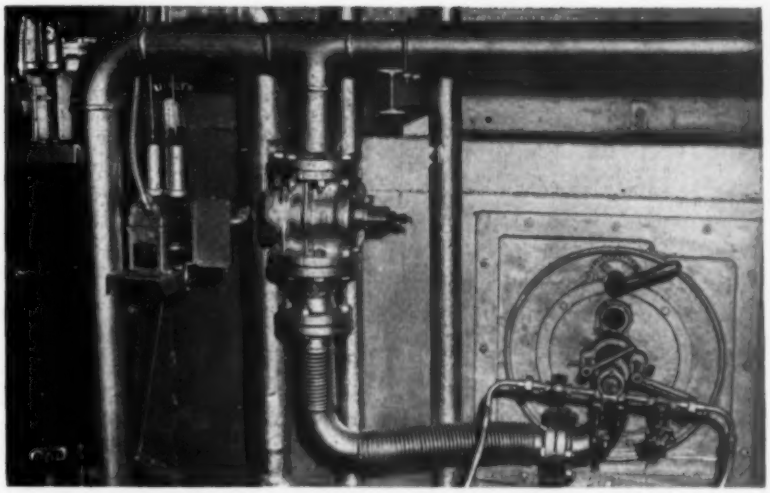
Close-up of firing platform on steam generator in left background of photo at the top of this page shows relative locations of the gas and oil burners



Panel for unit at left includes both instruments and combustion controls



Engineer checks performance on panel in power plant at a state university



Controls at left regulate the operation of these combination gas-oil burners. Upper power unit governs gas flow and the lower power unit controls oil flow

NATURAL GAS is nature's nearest approach to a perfect fuel because it is practically free from noncombustible gas or solid residue. It is very uniform in heat value and burns rapidly leaving no refuse which eliminates the disposal problem associated with solid fuel firing. Since natural gas is readily adaptable to constant pressure control, it is being used in all sizes of steam generating plants and for numerous industrial applications where solid fuels cannot be used successfully.

Various by-product gases, such as coke oven gas, refinery gas and blast furnace gas as well as manufactured gas, principal product of gas producers, also are employed for heating and steam generation. Although these gases usually vary in character more than natural gas, they are easy to use and to control either individually or in combination with other fuels. Since many arrangements are possible, this article is confined to controls for industrial steam generators that use only gas.

Types of Burners

Both low pressure (approximately 1/8 to 5 psig) and high pressure (up to 25 psig) burner designs are available for use with different types of gas and for a wide variety of applications. Most steam generating units utilize the latter design and operate at pressures of 2 to 25 psig. These high pressure burners may be classified in four main types, namely: (a) gas ring, (b) center diffusion tube, (c) turbine, and (d) tangential.

Gas burners can be obtained for either natural or forced draft operation. On both types, any adjustments, such as position of gas nozzles or rings and burner louvres for the control of air distribution, are designed for manual operation. Some natural draft types do include louvres or dampers at the burners for regulation of the combustion air volume, however, and these may be controlled automatically.

Gas flow to all the burners under each steam generator is controlled by means of a suitable valve in the main gas line. This valve must be correctly sized and should have proper characteristics for the control system with which it is to be used in order that accurate flow regulation can be obtained over a wide range of operation. Preferably, gas flow should be under the jurisdiction of the master steam pressure controller, either directly or through some intermediate medium such as a gas pressure controller, flow controller or valve positioning controller. This applies to both natural and forced draft type burners.

When the air for combustion is obtained by natural draft, the volume may be controlled by holding the furnace draft constant and adjusting the burner louvres. The preferred method, however, is to increase the furnace draft by opening the boiler outlet damper when greater quantities of gas must be burned to satisfy the load demand. Some burner designs use the flow of gas to induce a flow of air proportional to the flow of gas without further control.

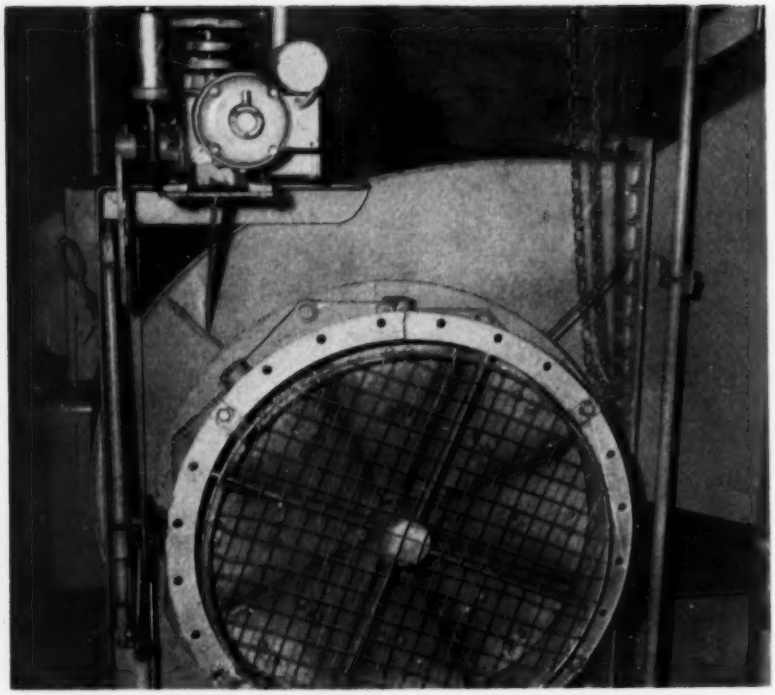
Most systems control the air for combustion from calibrated measurements of the air flow. This arrangement is more desirable than depending on direct positioning of dampers or louvres to give the desired results, since variable draft conditions and damper characteristics make it difficult to establish a definite relationship between damper position and air flow. With forced draft type burners, constant furnace draft should be maintained by a separate controller operating independently of the controls for steam pressure, gas and air flow.

Off and On Type Control

Often, gas is burned intermittently using off and on type controls for regulation. However, this arrangement is used only on small steam generators because it is limited in its ability to control steam pressure and efficiency. In operation, the pressure switch opens and closes a valve in the gas line when the steam pressure reaches predetermined set limits. In some instances, louvres are operated simultaneously to control most of the air used for combustion, but means should be provided for control of the outlet damper so minimum furnace draft will be maintained both while the burner is in operation and during the off period. With controlled furnace draft, air supply can be held at the required value for best efficiency during the on period without causing excessive air leakage during the off period.

Diaphragm Valve Control

One common method of gas control is the use of a diaphragm valve. Steam pressure either directly or through a pilot control is impressed on the diaphragm valve, which controls gas flow to the boiler in accordance with the load demand. This method is employed only on small continuously fired boilers because it does not hold steam pressure within close limits or provide for the control of air flow in proportion to gas flow. Thus, high efficiency is not obtained unless a fuel-



Primary air flow control is an important consideration. At this plant, a power unit controls this detail by positioning inlet vanes on the forced draft fan

air ratio controller is added to complete the combustion control system.

Positioning Control

Combustion control systems of the positioning type may take various forms but the basic principles remain the same. A master steam pressure controller responds to changes in steam pressure in the main header and actuates a power unit that positions the gas control valve and air control medium simultaneously. The air flow control medium may be the boiler outlet damper, the burner louvres or both. If forced draft burners are to be controlled, a furnace draft controller to maintain constant furnace draft is required in addition to the master controller. This unit may operate the outlet damper or inlet vanes on the forced draft fan or the outlet damper on the boiler itself.

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Positioning control systems maintain very uniform steam pressure, but the combustion efficiency achieved depends upon the correct mechanical matching of valve and damper movements and characteristics. Installing this linkage generally proves to be a difficult and tedious task, and even when the setting is fairly accurate, efficiency is affected by variable gas pressure and draft conditions. Then manual changes in the linkage are required to obtain optimum performance.

Metering Control

Metering controls are preferable to the other types previously mentioned and are used frequently on large steam generators because they provide more uniformly high efficiency over the entire range of operation. This method of operation features control of burner gas pressure, metering of gas and air, base loading control, adjustments for load distribution and fuel-air ratio, and remote manual control.

In application, these systems utilize one master steam pressure controller with either proportional or proportional plus floating action. This unit measures pressure in the main steam header and, through fuel feed controllers, establishes the steam output of each boiler connected to the system.

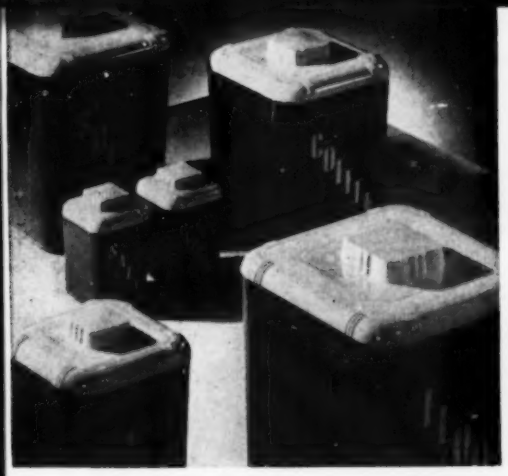
Individual adjustable pressure fuel feed controllers position the gas valve to each boiler through a power unit. The master controller establishes the boiler rating by setting the fuel feed controllers for the gas pressure to be maintained at the burners while the fuel feed controllers measure the gas pressure and balance it against master loading. Control of gas pressure is not dependent upon valve position alone. The correct minimum gas pressure is maintained in a multiple burner system regardless of variations in gas supply pressure or the number of burners in service. This affords protection against loss of ignition. Furthermore, an adjustment is provided to increase or decrease boiler output with respect to master loading.

In the metering system, fuel-air ratio controllers proportion air flow to gas flow by controlling the forced draft dampers. These controllers have two differential diaphragm elements. One of them measures the pressure differential across an adjustable orifice in the gas line while the other measures the pressure differential across an orifice in the air duct, or draft loss through the boiler where practical. In both cases the differential pressures vary as the square of the flow and can be balanced directly in the controller. Any unbalance, resulting from a change in gas flow or air flow, causes the controller to adjust the forced draft damper.

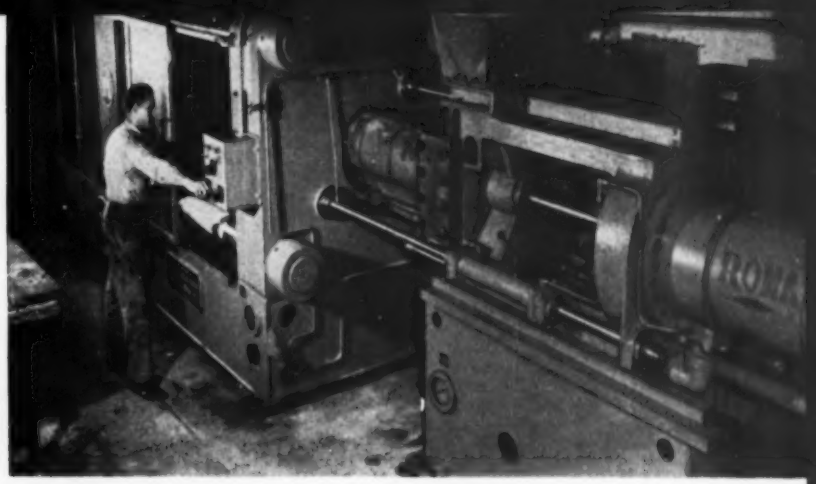
Since fuel-air ratio controllers automatically proportion air flow to gas flow, the proper fuel-air ratio can be maintained with the gas valve being controlled either manually or automatically. If a valve for a fan turbine drive, a lever on a hydraulic coupling, or a rheostat on a magnetic coupling is to be controlled instead of the damper, a proportional plus floating controller is substituted for the proportional speed floating controller. A combination of fan speed and damper control also can be obtained.

In addition to the controllers mentioned, each boiler is equipped with a separate furnace draft controller that maintains constant minimum furnace draft. This unit operates independently of the master, fuel feed, and ratio controllers, but its action for damper or fan speed control is similar to that of the ratio controller. Each furnace draft controller includes a calibrated draft set point adjustment.

Additional controllers can be furnished for limiting the fuel and air input to the available draft, for limiting fuel to the available air supply, and for shutting off the fuel if the limiting action is ineffective after a definite time interval. Manual to automatic transfer switches can be interlocked to necessitate a definite sequence of transferring power units from manual to automatic control. Additional interlocks for starting up are available.



NO MORE PROBLEMS. The production of plastic household items by Rona Plastic Corporation was slowed down by an inadequate hydraulic oil. A switch to Sunvis 999, over a year ago, restored it to normal.



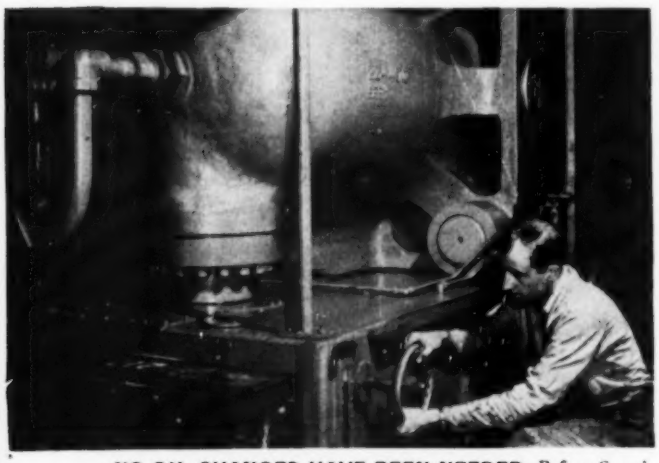
PRESSURE LOSSES ENDED. There are few plastic molding machines as big as this 60 ounce model. It exerts a pressure of 1,000 tons. Because the hydraulic oil formerly used sludged up and thinned out, it could not maintain this pressure. But Sunvis 999 has fully met these severe requirements, as well as those of Rona's nine other hydraulic machines of varying sizes.

PLASTIC MOLDER'S BOTTLENECK ENDED BY SUNVIS HYDRAULIC OIL

More than a year ago Rona Plastic Corporation, New York City, had trouble with its hydraulic molding machines. The machines functioned erratically due to oil sludge sticking the control mechanisms. In addition, the oil thinned out excessively at normal operating temperatures, and resulted in the loss of proper clamping pressures on the dies. To keep the machines going at all, it was necessary to drain, clean, and entirely recharge the systems at frequent intervals.

A Sun representative, called in by Rona, studied the problem and recommended Sunvis 999. He knew it would put an end to pressure losses, because, even at elevated temperatures, it does not decrease in viscosity as much as most other oils. He also knew its exceptional stability would end the sludging problem.

Sunvis 999 proved to be the answer to all Rona's hydraulic oil problems. The original charges, with minimum make-up, are still giving good service. Rona can expect the same performance for a long time to come, because experience shows that under normal operating conditions, Sunvis 900 Series Oils are *good for the life of the equipment.*



NO OIL CHANGES HAVE BEEN NEEDED. Before Sunvis 999 was adopted, the oil in each of the machines had to be changed frequently (the one pictured holds 450 gallons). The original charges of Sunvis 999 have been in use now for more than a year.

Department IP-3
Sun Oil Company, Philadelphia 3, Pa.

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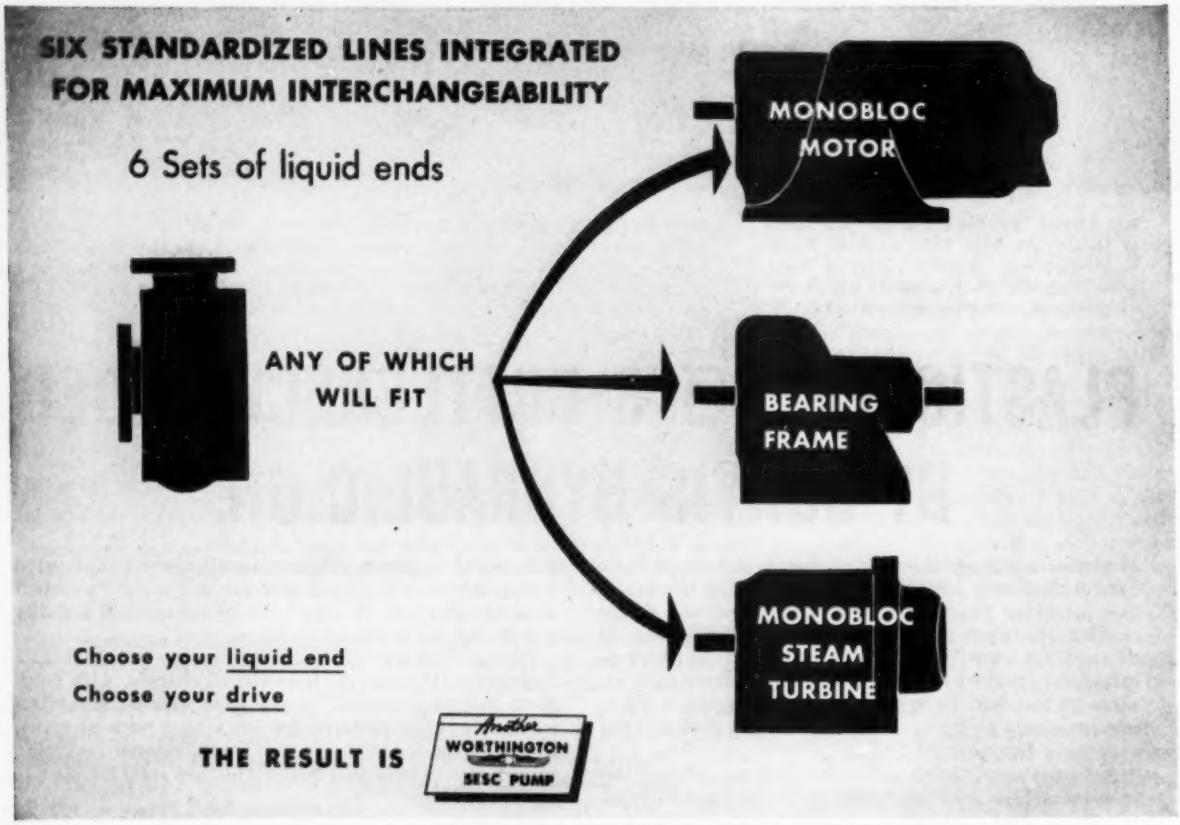
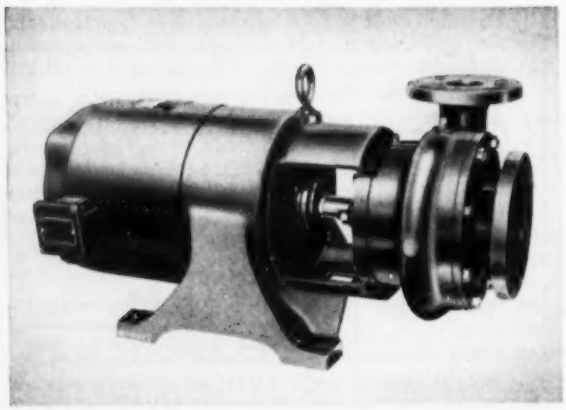
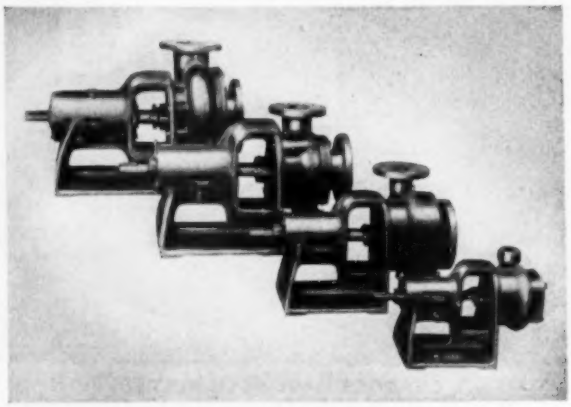


WORTHINGTON STANDARDIZATION assures you the one *right* pump for every job. Most "specials" can be assembled from standard parts and shipped to you without delay.



THE WORTHINGTON MONOBLOC, the pump with a built-in motor, has long been famous for its compact, streamlined design. It handles many different jobs because it uses any of the six liquid ends that are interchangeable and can be equipped with either conventional packing or mechanical seal.



FRAME-MOUNTED PUMPS use the same rugged mounting as the monobloc units and the six liquid ends fit in four frame sizes. Like the monoblocs, they use a standardized mechanical seal that can easily be changed in the field if necessary. They'll take any kind of drive readily available.

standard pumps do special jobs

Worthington's SESC* line provides for "custom" assembly from standardized parts with standardized mountings, materials and dimensions to give you exactly the centrifugal pump you need

When you order a Worthington centrifugal pump you get the one *right* pump for the job without compromise, without long delays and without paying a premium for a pump to meet "special" requirements.

Worthington can assure you this, because Worthington can assemble any of 60,000 *different* standard pumps, covering virtually every possible application, from 650 standardized parts. Nearly all *special* pumping needs can be filled with a Worthington *standard*.

Worthington SESC centrifugal pumps are husky and well-built—not flimsy, light-duty units. In fact, users find them of better construction than is usually available in custom jobs at higher prices.

To sum up, you can expect the following advantages when you buy Worthington centrifugal pumps:

- **Greater availability,** since Worthington is equipped to handle more requirements with a *standard* unit.
- **Broader selection** of ratings and special design features.
- **Easier servicing** with lower parts-inventory requirements.

Contact your local Worthington distributor or nearest Worthington district office. Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey.

*SESC—Standardized End Suction Centrifugal C.2.14

MANY YEARS OF DEVELOPMENT WORK coupled with Worthington's 112-year pumping experience has led to the development of the present Worthington line of centrifugal pumps. This is a view of a section of Worthington's Engineering Department which includes specialists in virtually every field of industry. C.2.14

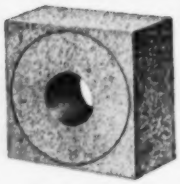
The World's Broadest Line Assures You The Right Pump For Every Job

WORTHINGTON

Centrifugal Pumps

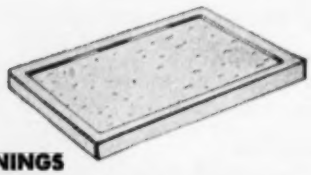
There's no end to the uses of economical

B&W KAOCAST



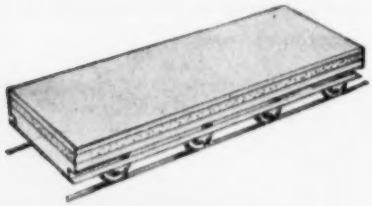
BURNER BLOCKS

Kaocast lasted 3 to 6 times as long as previous refractory. Still going strong.



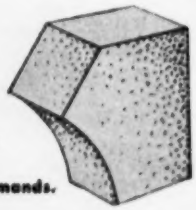
DOOR LININGS

Kaocast lasted 3 to 6 times as long as previous refractory—cut installation cost in half.



TUNNEL KILN CAR TOPS

Ordinary fireclay crumbled after few trips. Kaocast lasted 400 trips without deterioration.



SPECIAL SHAPES

Kaocast special shapes cast over week-end to meet production demands.

BOILER FURNACE REPAIRS

One power plant keeps a ton of Kaocast on hand for miscellaneous repairs because it is so versatile.

The list of plants who are discovering new, cost-saving uses of versatile B&W Kaocast keeps growing all the time. The reasons? This unique 3000 degree refractory castable can be molded in a hurry . . . cast directly in place . . . applied with a cement gun. It eliminates the need for a large inventory of special shapes. It has high resistance to spalling, low volume change, practically no reheat shrinkage. Want to know more? Ask your B&W Refractories Engineer—or write for Bulletin R-22.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

B&W REFRACTORIES PRODUCTS — B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick B&W Refractory Castables, Plastics and Mortars • OTHER B&W PRODUCTS—Stationary & Marine Boilers and Component Equipment . . . Chemical Recovery Units . . . Seamless & Welded Tubes . . . Pulverizers . . . Fuel Burning Equipment . . . Pressure Vessels . . . Alloy Castings

Selection and Application of Cables . . .

for Network Service

FUNDAMENTAL PURPOSE of networks, of course, is to provide highly reliable service from one or more power sources. Service must be uninterrupted in the event of cable failure or transformer breakdown at one source or for other reasons.

This discussion concerns low voltage networks as used in city streets or industrial plants. They are rugged, simplified for economy and very suitable for the purpose.

Networks usually are installed underground in ducts for greater reliability but, of course, may be overhead. Cable selection, therefore, must be made to meet both installation conditions and the general operating plan for the network. Important items are:

1. Long life under exposure to moisture and normal concentrations of acids, and to alkalies.
2. Resistance to oxidation and heat.
3. Overload capacity.
4. Stability under overload.
5. Fault clearing characteristics.
6. Ease of pulling and jointing.
7. Over-all reliability.

Network cables almost invariably are single conductor for ease in pulling in ducts, ease in making service taps (single phase) and because, in case of burn-off, a minimum of damage is inflicted on the other cables of that circuit. It is sometimes desirable to install more than one cable in a duct (often the practice in congested districts and for smaller sizes). Single conductor cable can be furnished, if called for, with two or three wrapped in parallel or three or four twisted together on one reel ready to pull in. This provides greater convenience and time saving in installation and reduces abrasion of the cables to a minimum.

Abstracted by courtesy of Anaconda Wire and Cable Co. from general Catalog No. C-79. Because of its wide general interest, this material was selected from the catalog, which gives detailed information on all common cables including types not made by the company. This is the second of a series of articles on various types.

Explosibility Range

The question arises occasionally as to the explosibility range of gases formed by certain network rubber insulating compounds when, under short-circuit conditions, the conductor is burned off. This situation has been thoroughly investigated. Network compounds should and may have the narrowest explosibility range for any available insulation of this type. Further details are found under discussions of network compounds in manufacturers' literature.

Network Cable Construction

Three principal types are favored for network operation, each having a desirable set of characteristics and each able to satisfy the important characteristics set forth above. Other types are in use and can be furnished but are not discussed here for lack of space. The principal ones are the paper-lead type, rubber or synthetic rubber and cotton braid or rubber braid type, and rubber or synthetic rubber with neoprene jacket or lead sheath.

Paper-Lead Type

Paper-lead cable is widely used and is chosen for its high reliability. The sheaths provide additional paths for neutral current when used in a grounded neutral three or four wire system and insure positive relay action. It will withstand overloads well and is less subject to deterioration over the years from hot spots or sustained high current. The sheath has the disadvantage of being subject to electrolysis and to corrosion under certain conditions of acid or alkali concentration in earth waters and, therefore, is safer in dry locations.

This cable comes in sizes from No. 6 Awg to 1,000,000 cir mils, or larger if desired by the customer.

Rubber-Lead Type

Much the same can be said for this construction as for paper-lead, though it may not have the same long life. It is used in large quantity.

Rubber-lead cables have an advantage in that the insulation is moisture resistant, or can be selected with that property, and will operate after the sheath integrity is impaired. Insulation with 75 C operating temperature will withstand short-time overloads, but not so well as paper (85 C at 600 v). Another advantage is freedom from braid rot, as in neoprene-jacketed cables.

Insulations for this purpose are predominantly moisture resistant (RW) and heat resistant (RH) and some oil base types. Type ANW® (Anaconda) is both moisture and heat resistant and is capable of continuous operation at 75 C copper temperature.

Rubber with Neoprene Jacket

For unfavorable underground conditions such as continuously wet ducts containing acid or alkali waters, some operating companies prefer the additional safety and protection gained by the use of a neoprene jacket over the rubber insulation. This has become the standard non-leaded construction. The rubber usually is Type ANW or equivalent, or performance grade.

Neoprene jacket is highly reliable because of its (a) high resistance to abrasion, (b) high degree of resistance to oils, acids, alkalies and (c) high degree of resistance to sun's rays. It can be buried directly in earth or installed in ducts, conduit or in air.

No covering is placed over the jacket and the cable is installed as the bare, jacketed unit. Besides the advantages listed for the jacket, there is the additional advantage of freedom from braid deterioration. Burn-off characteristics are good, the cable is easy to pull and jointing is simple. The cable

is furnished in sizes No. 6 Awg to 1,000,000 cir mils, or larger if desired.

Type ANW with Tape and Braid

Since 1931, millions of feet of this cable have been installed with unquestionably highly satisfactory results. The insulation is a rubber compound especially designed for network operation and has the advantages of any good network insulation. They are:

1. High resistance to moisture.
2. High resistance to heat and flame.
3. High overload capacity.
4. Low explosibility range of gases formed when insulation burns.
5. Resistance to oils, acids, alkalies.
6. Long life by resistance to deterioration due to oxidation and heat.
7. Easily handled under a wide range of climatic conditions.

The tape and braid covering provide good mechanical protection during installation. The braid is well saturated with a moisture resistant, flame retardant compound, but under conditions such as wet ducts containing bad waters, the braid eventually may rot. This, of course, will not occur in dry locations. This cable has proved highly satisfactory because of the remarkable characteristics of the insulation. It is furnished in sizes No. 6 Awg to 1,000,000 circular mils with lead sheath as well as tape-and-braid covering. The braid covered cable is finished with a slipper compound and dusted for easy pulling. Jointing is simple.

for Aerial Cables

THERE ARE two general categories in which aerial cables are installed although there may be other special ones. These two categories are (a) high and medium voltage cables on poles for moderately long lengths where the expense of ducts is not justified, and (b) medium and low voltage cables along streets and roads where open-wire construction is unfavorable due to trees and other obstructions.

There is no actual limit to the voltage rating for aerial cables. Above 27 kv, however, overhead lines or ducts usually are justified for economy and safety. For voltages 12 kv and above, paper and rubber insulation are common. Due to the necessity for oil and reservoirs and to the movement of oil in the insulation from changing load and temperature, paper above 22 kv is uncommon.

Paper, rubber and varnished cambric are used for insulation on feeders operating at 15 kv and lower. Installations and operation in this voltage range are fairly easy to handle. Varnished cambric is frequently used for temporary installation without lead sheath but with flat steel tapes and one or two layers of rubber faced tape overall, and painted with a moisture proof paint or using a hose-type jacket.

Rubber insulation is used for tree wire.

There are three general types of construction for aerial cable:

1. Plain or alloy-lead sheathed or metallic armored, suspended in rings from a messenger.
2. Aerial cable with the messenger incorporated in the cable at the factory (self supporting), or assembled with a spinner in the field.
3. Tree wire, a single conductor cable supported by its own conductor.

Ring Suspended Types

Plain or alloy-lead sheathed cables usually are for high or medium voltage use as already noted. Their installation requires handling differing very little from duct cables, principally in proper method of support and training. Potheads are required.

Metallic armored construction may be used over nonleaded cable cores, providing a lighter construction but protected against weather. Armor construction may consist of either flat or interlocked metal tapes. They are used for signal control cables along railroad rights-of-way and similar purposes. They have the advantages, besides lighter weight, of greater ease in handling and terminating, lower cost and availability in long lengths.

Metals used besides galvanized steel are bronze and zinc.

Self Supporting Aerial Cable

Self supporting aerial cable of the type described here has many advantages. It can be assembled with single conductor cables, each covered with a neoprene jacket for long life and having comparatively low weight. The messenger may be assembled with the cable at the factory with a copper strap served around the assembly. It may also be formed along the pole line with copper or copperweld wires served around the assembly by means of a "spinner", usually hauled along the messenger by a rope from the ground. This makes a snug, serviceable construction. The same construction also may be installed in cable rings attached to a messenger. Insulation usually is a special type rubber compound with long aging and low moisture absorption characteristics. Individual conductors may be shielded if desired, and the shields grounded to the messenger at joints and terminals.

Advantages of aerial cable circuits assembled in the field are that there is less waste in erection, and stock in the warehouse is more flexible as the same cable can be used for other purposes.

Power in fairly good size blocks can be carried by aerial cable on existing pole lines with comparatively little additional expense other than for the cable itself. Inherent protection is provided against falling limbs and against abrasion.

Tree Wire

Tree wire is the name given to a design of single conductor insulated cable with a tough, abrasion resistant jacket. It is particularly adapted to running circuits through trees where trimming is expensive or prohibitive, usually on circuits such as those for primary distribution and street lighting. It is suspended in the usual manner on insulators and connected at each end to the bare or weather-proof line wires. The medium hard drawn copper conductor itself supports the cable.

Aerial Cable Joints

Where leaded joints occur on aerial lead covered cables, it is necessary, especially in larger sizes, to drop the cable to make room for the joint under the messenger. This requires, of course, sloping the cable down somewhat to the joint sleeve. That can be accomplished by omitting one or two hangers and substituting marlin ties to the required length.

The same procedure can be used where cables pass the pole and beneath the clamp or other messenger support or where a joint occurs at or near the pole.

If a leaded cable is to be spliced to a non-leaded type, one method for making a water and oil tight joint is to slip a close fitting lead sleeve, about 18 to 24 in. long, over the non-leaded cable and proceed as with lead covered construction. The far end of the sleeve, over the non-leaded cable, is protected from the entrance of moisture by alternate layers of suitable rubber tape and asphaltic paint over the sleeve end and on the cable.

Terminals

Aerial cables normally require porcelain potheads except for some 600 v, rubber insulated cables and occasionally for high voltage cables with special terminals. Recently, a simple terminal without porcelain for 5 and 8 kv, single conductor, shielded type non-leaded aerial cables has been developed. It can be installed by line crews in cold weather with simple tools.

You've got a Winning Combination

A STANDARD ISA FACE-TO-FACE DIMENSIONS
K "FLOW LINE" CONTOURED BODY
Q STELLITED SEATING SURFACES
J RENEWABLE SELF-ALIGNING GUIDES
10 SEAT RINGS EASILY REPLACED WITH VALVE IN PIPE LINE

with the New

TRADE **LESLIE** MARK

DOUBLE SEATED DIAPHRAGM CONTROL VALVES

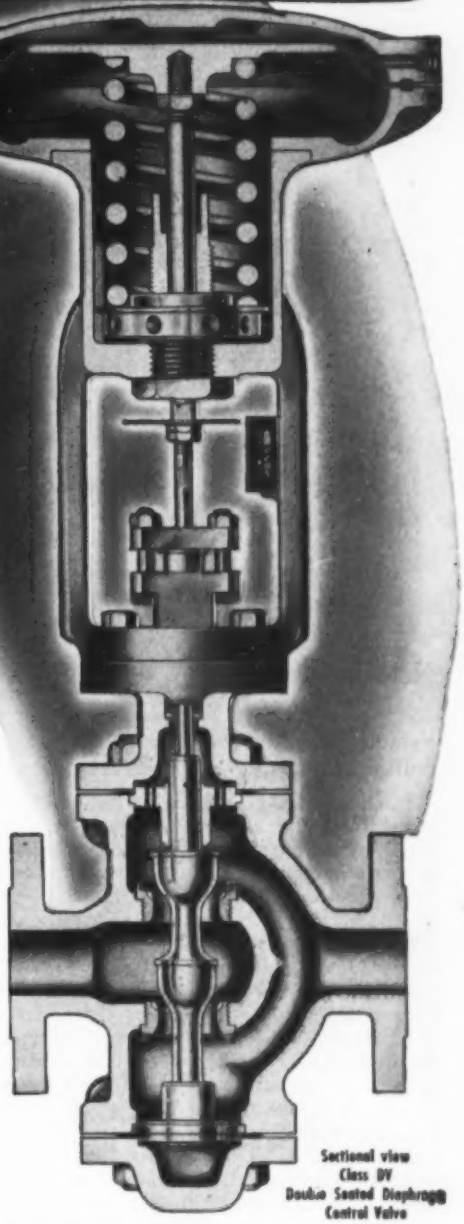
Calling a spade a spade you've got a "royal flush" of features in these new Valves designed for use with control instruments.

Their "Flow-Line" Contoured Bodies have ISA standard face-to-face dimensions and high capacity, low turbulence and minimum body pressure drop characteristics.

A new type, top and bottom guided construction is self-aligning and non-binding regardless of uneveness of bolt tightening.

Standard, integral stellited seating surfaces are recommended for steam service to reduce seat ring thread corrosion. Renewable, interchangeable seat rings also furnished where desired and may be easily replaced without removing valve body from the line. Elaborate grinding at high temperatures is completely eliminated.

With these Valves, you get as *standard equipment*, features heretofore only obtainable in expensive, specially designed valves.



Sectional view
Class DV
Double Seated Diaphragm
Control Valve

Look for LESLIE REGULATORS under "Valves" or "Regulators" in your classified telephone directory in the following cities where LESLIE factory trained engineers are located:

Albany, N. Y.	Chicago, Ill.	Galveston, Tex.	Memphis, Tenn.	Orlando, Fla.	Salt Lake City, Utah
Albuquerque, N. M.	Cincinnati, Ohio	Greenville, S. C.	Miami Springs, Fla.	Philadelphia, Pa.	San Francisco, Calif.
Atlanta, Ga.	Cleveland, Ohio	Houston, Texas	Milwaukee, Wis.	Pittsburgh, Pa.	Seattle, Wash.
Baltimore, Md.	Dallas, Texas	Indianapolis, Ind.	Minneapolis, Minn.	Ponca City, Okla.	St. Louis, Mo.
Beaumont, Tex.	Denver, Colo.	Kansas City, Mo.	Mobile, Ala.	Providence, R. I.	Syracuse, N. Y.
Birmingham, Ala.	Des Moines, Ia.	Kingsport, Tenn.	Monroe, La.	Richmond, Va.	Tucson, Ariz.
Boston, Mass.	Detroit, Mich.	Los Angeles, Calif.	New Orleans, La.	Rochester, N. Y.	Wilkes-Barre, Pa.
Bridgeport, Conn.	El Paso, Tex.	Louisville, Ky.	New York, N. Y.	Rutherford, N. J.	Wilmington, Calif.
Buffalo, N. Y.					Youngstown, Ohio

Bruxelles-Forest, Belgium

Montreal, Que., Can. • Ottawa, Ont., Can. • Toronto, Ont., Can. • Vancouver, B. C., Can. • Welland, Ont., Can.

***WRITE FOR* Bulletin 513**

ESTABLISHED 1900 **LESLIE CO.**

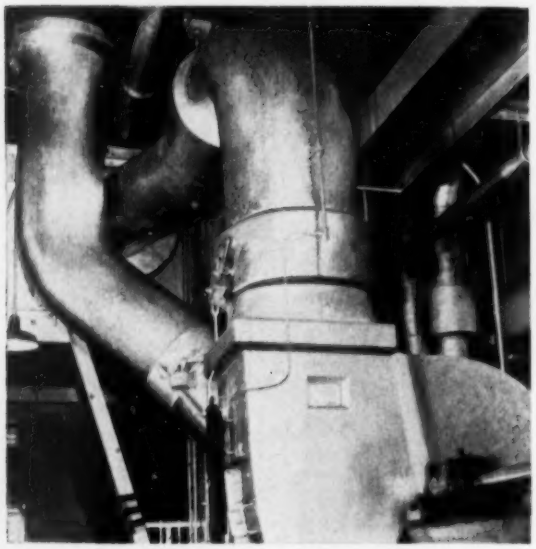
263 Grant Avenue, Lyndhurst, New Jersey

¶707

PRESSURE REDUCING VALVES • PRESSURE CONTROLLERS
FLOATLESS LEVEL CONTROLS • PUMP GOVERNORS • TEMPERATURE REGULATORS
SELF CLEANING STRAINERS • AIR HORNS • STEAM WHISTLES

spot news

of what's happening in U. S. industrial plants



Versatile Combination Insulates Both Flat and Curved Surfaces

Flat, curved and irregular heated surfaces of auxiliary power plant equipment often results in an assortment of insulating materials and application techniques. Total cost is then unnecessarily high because of excess installation time, and because materials are purchased in uneconomical quantities. Engineers at the 170,000 kw Glenwood Power Station of the Long Island Lighting Co. are reported to have reduced installation cost by specifying a versatile combination of materials and application that has resulted in efficient insulating performance on virtually all such surfaces.

In the illustration, a fan housing and two circular ducts are insulated with one layer of 24 x 48 in. blankets followed by a 1 in. thickness of mineral wool insulating cement applied in two coats. The blankets, with wire netting on the inside surface and expanded metal lath facing on the outside, are impaled over 3¼ in. long, 9 gage galvanized wires welded perpendicular to the surface on about 8 in. centers. The blankets are tightly butted together and laced on all edges with 16 gage wire, and the ends of the welded wires are bent over into the metal lath. The first layer of insulating cement is troweled into the expanded metal lath and allowed to dry before the second layer is applied Two coats of aluminum paint complete the insulation.

The Cover — Control Valves

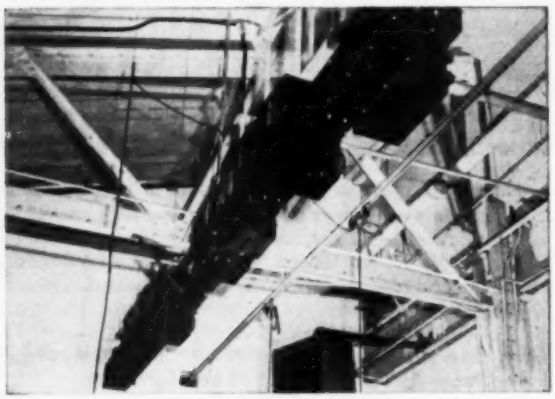
This month's four color illustration, taken in the air conditioning equipment room of Powers Regulator Co., refutes the old adage "that the shoemakers children go barefoot."

The main control unit is called a Flowrite diaphragm valve, and it modulates the flow of water used in the conditioning systems.

Manufacturer's Experiences Emphasize Importance of Flexibility in Busway Systems

In the past ten years, engineers of Rockwell Manufacturing Co. have had many opportunities to appreciate the advantages of using a flexible system for distribution of electrical power to production machines. The experiences of the Pittsburgh DuBois Div. provide a good example.

Industrial plug-in busway systems, manufactured by National Electric Products Corp., were installed in the original parent plant. Later, when manufacturing facilities were relocated, the runs of busway also were removed and installed



Several types of load connecting devices are shown in this view of a 600 amp plug-in busway at Rockwell's DuBois plant

in the new quarters. As further production shifts were made, it likewise was found that these units could be extended or relocated with a minimum of effort and with every foot of old installation usable.

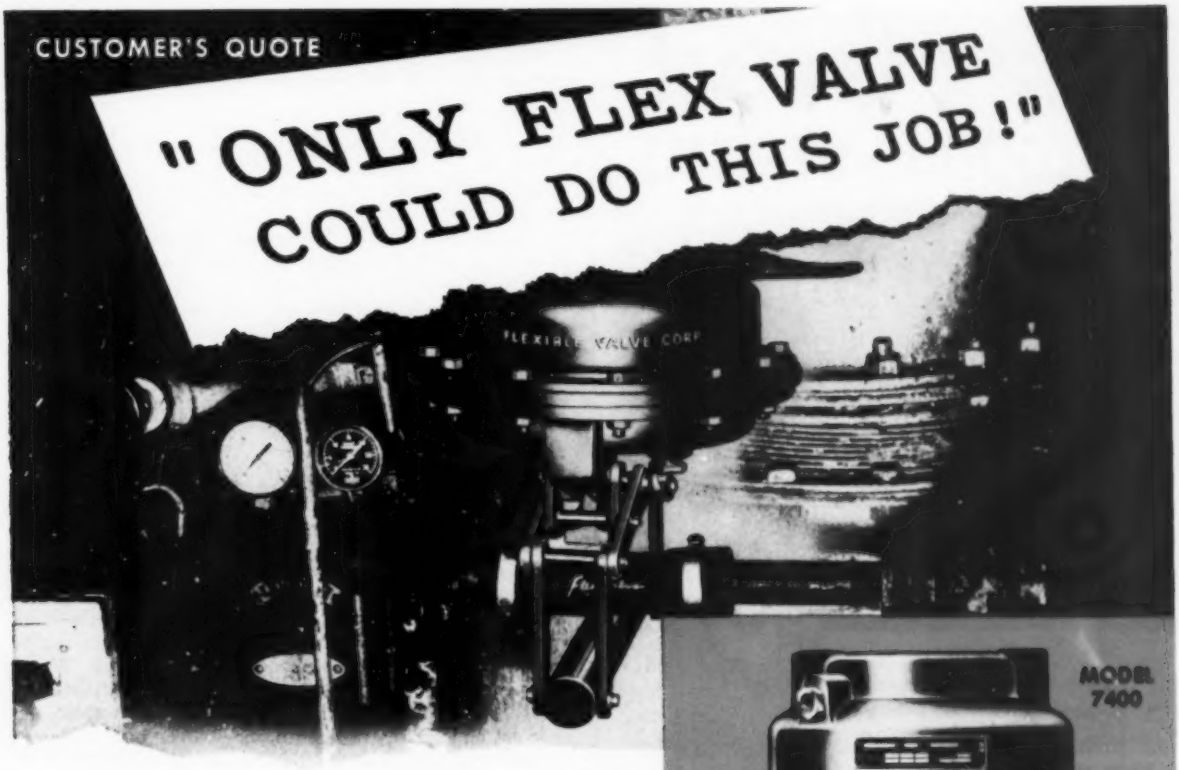
About two years ago, changes were ordered in the distribution systems servicing production machines in many of the company's divisions in other parts of the country. With the discontinuance of certain machine operations at the parent plant, much equipment was moved to other divisions. In addition, some 1000 ft of busway was relocated in the parent plant. Then still further changes resulted in freeing of more lengths, and much of this was removed and shipped to other divisions.

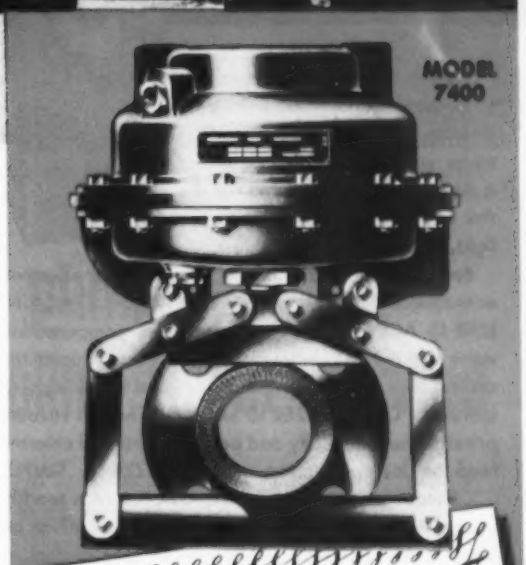
Despite the fact that this busway system had been in use for more than ten years, had been re-installed several times and then finally had been removed entirely and sent elsewhere, the lengths were described by Rockwell officials as being "fully salvable," and when installed in plants where

(Continued on page 126)

CUSTOMER'S QUOTE

"ONLY FLEX VALVE COULD DO THIS JOB!"





This diaphragm motor-operated Farris Flex Valve is handling a hard-to-convey, semi-solid slurry in a leading chemical processing plant. Before it was installed, other types of valves clogged after as little as a few hours' service. *Yet Flex Valve has performed perfectly for more than 3 years, in a 24-hour, 7-day-week operation.* Many other Flex Valve installations have been giving trouble-free, continuous service for 15 years or more. If you have a problem in controlling flow of any hard-to-handle fluid, send for Catalog No. FL 382. E

Exclusive FLEX VALVE Features (Pat'd & Pat. Pending)

- Will outwear any metal valve on abrasive service. Proven minimum 11 to 1 life over metal.
- Full pipe capacity.
- Will not freeze up in outdoor service.
- Excellent control characteristics in first ⅓ of travel.
- Complete closure for bubble-air tightness.
- Tight on grits up to ⅛".
- No obstructions, pockets, or internal parts.
- Valve body available in pure gum rubber, neoprene, butyl, buna-n, buna-s, food stock and special compounds.

We Guarantee
YOUR MONEY BACK
if Flex Valve plugs

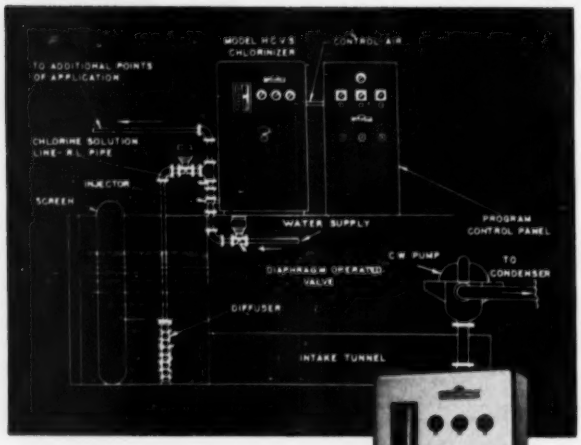
Farris

Representatives in Principal Cities

FLEXIBLE VALVE CORP., Palisades Park, N. J., U. S. A.

Affiliates: Farris Engineering Corp. • Farris Stacon Corp. • Farris Hydroseal Corp. • Farris Hydrotorque Corp.

Slime Control IN COOLING SYSTEMS



Chlorination — the modern way to prevent slime buildup in condensers and heat exchangers — saves you money if it's right. But if dosage is too heavy, you run the risk of corrosion . . . or if it's too light, chlorination is worthless.

Builders Chlorinizer is the key to safe, effective, economical chlorination in cooling systems. CHLORINIZER IS ACCURATE . . . The sensitive compensating valve and the visible-flow Sightflo Indicator guarantee correct feed for effective treatment and insure against corrosion. CHLORINIZER IS SAFE . . . The full vacuum principle automatically and positively shuts off chlorine feed on loss of vacuum. CHLORINIZER IS SIMPLE . . . Because of its basic design, Chlorinizer is readily adaptable to single or multiple point applications on manual, semi-automatic, or fully automatic control.

Builders Chlorinizers are available in three volumetric models for feeding from a few pounds to 6,000 pounds per day. Send coupon for complete details.

BUILDERS-PROVIDENCE, INC.

BIF INDUSTRIES (DIVISION OF B-I-F INDUSTRIES) BUILDERS

35 Harris Avenue, Providence 1, Rhode Island

Please send Application Memo No. 840-J9 describing Chlorinizer slime control system.

Name.....

Company.....

Street.....

City..... State.....

spot news

(Continued from page 124)

they are in constant use, "were as good as new, with no need of any kind of repair."

In describing the actual installation of the system at the DuBois plant, Chief Electrician L. E. Johnson pointed out that it was laid out with all foreseen extensions planned for. In describing the advantages, he stated "that through the use of plug-in busway, machines on the production line can be plugged in, disconnected, or re-located at any time without shutting down the production line." Also, "long tap runs are eliminated since feed-in and tap-off fittings, with plug-in openings staggered on two sides of the lengths, permit insertion of devices convenient to equipment."

Refrigeration Chemical Helps Electronic Device Find Leaks

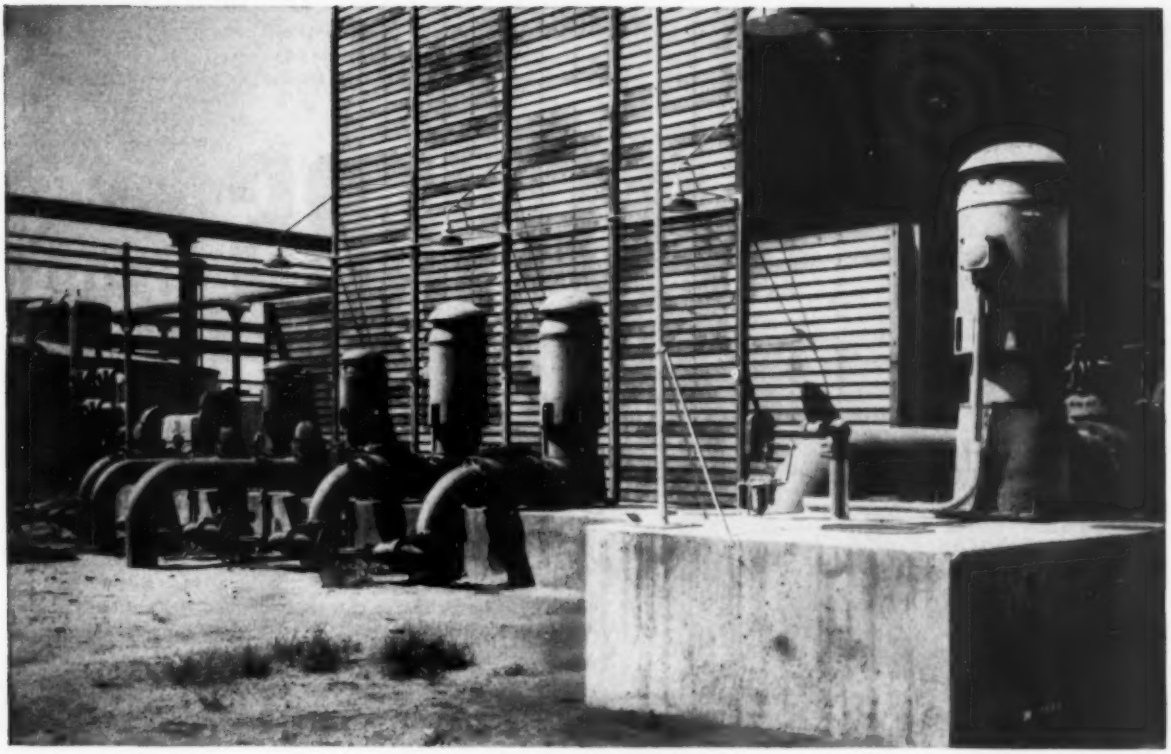
For finding leaks in anything from a football to a complicated coil or pipe, a nearly fool-proof method has been developed using a gas that once served only as the cold-making agent in refrigerators. The test medium is Du Pont Freon-12 fluorinated hydrocarbon which, under pressure, is a colorless, virtually non-toxic and odorless liquid. When released from pressure at room temperatures, it changes to a gas. Its use as a leak detector stems from its ability to seek out and escape through the finest openings in almost any material. The exact location can be found quickly with an electronic device, or with a gas-burning torch whose flame changes color in contact with the nonflammable Freon.

Halide torches, small lamps in which methyl alcohol, acetylene, or propane burns with an almost invisible flame, have been used for many years to detect leaks in Freon refrigeration systems. The sensitive flame turns a green or blue-green in the presence of the gas, and experts can tell how big the leak is by the flame color.

(Continued on page 130)

INSULATION PROTECTS WORKMAN'S HAND

Although molten zinc at 787 F is only 3 in. below, a layer of Vermiculite insulation, manufactured by Zonolite Co., protects the workman's hand. In use at a southern wire rolling mill, this material is placed on top of the hot zinc to maintain even temperature and prevent unnecessary heat loss. Passage of heat is retarded by tiny air cells contained in each particle of the mica-like mineral



WORTHINGTON VERTICAL TURBINE PUMP installation at The Derby Oil Company refinery in Wichita, Kansas. The pump on the extreme left is driven by a Worthington steam turbine.

Vertical turbine pumps— the logical choice for cooling tower service

During installation of a new cat cracker, The Derby Oil Company revised their entire cooling system at their Wichita, Kansas, refinery and purchased a new three section cooling tower. As part of this system, eight Worthington vertical turbine pumps were installed. Here are some of the inherent characteristics of vertical turbine pumps that make these units the logical choice for this application:

1. Drive unit is remote and separate from the pumping element.

2. No need for priming or expensive dry pits because pump always operates submerged.

3. No suction problems.

Worthington gives you the newest, best-engineered vertical turbine pump available today. Find out more about these modern Worthington units. Contact your nearest Worthington district office, or write to Worthington Corporation, Vertical Turbine Pump Division, at Succasunna, New Jersey, or Denver, Colorado.

D.7.8

The World's Broadest Line Assures You The Right Pump For Every Job

WORTHINGTON

Vertical Turbine Pumps

CONSERVE GROUND WATER—IT IS A VALUABLE RESOURCE AND IS NOT UNLIMITED

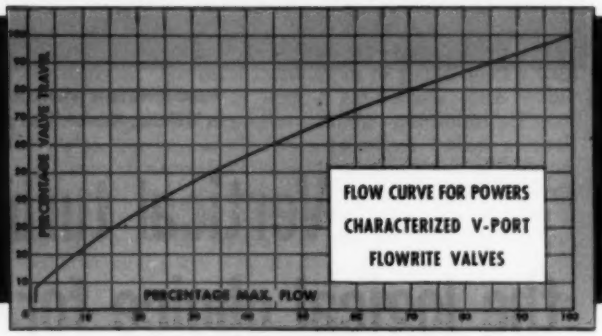
VALVE TOP—Durable moulded neoprene diaphragm (1) has positive sealing bead which provides increased sealing action with increasing control pressure. Efficient diaphragm form insures ample and constant operating power thru full travel. Piston Plate Assembly (2) has a free floating thrust plate which absorbs side thrust. Closely guided piston plate maintains stem in accurate alignment. Maximum air pressure in top, 22 psi.

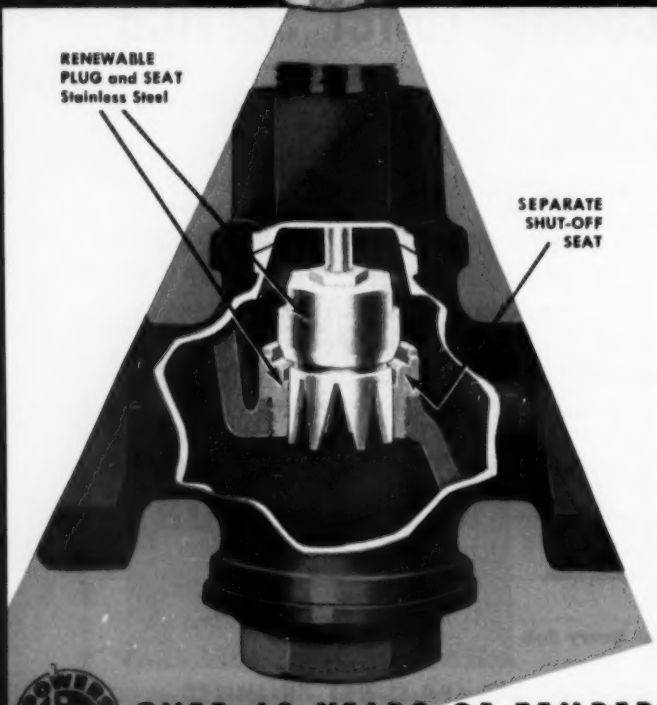
1
2
Special Cast Iron Housing and Top Only 4 Bolts
Compressed Air or Water Operated
BALL CHECK LUBRICATOR SILICONE grease for temperatures from 40° to 500° F.
Max. Pressure 250 psi.
Max. Temperature 450° F.
SIZES: ½" thru 2"
Direct and Reverse Acting

POWERS® SINGLE SEAT V-PORT *Characterized* FLOWRITE VALVES Give—

Special Flow Characteristics—High lift V-Port plug provides proportional flow throughout entire lift of stem as shown in chart below.

Wide Variety of Valve Sizes—Nine sizes are available, ½" thru 2". The ½" valve can be furnished with plugs to give 15%, 30%, 60% or 100% of maximum capacity. Plugs are easily interchangeable without removing valve from line.





Better Control—Less Maintenance—Superior design of stainless steel plug and seat reduces wire drawing, insures longer life and tight shut off. V-Ports do the throttling, protecting separate shut off seat. Plug and seat are truly removable and can be easily replaced in the field. Inner valves are machined and precision ground and lapped within very close tolerances.

Low Hysteresis—Due to smooth rolling diaphragm and polished stainless steel stem in preformed lubricated packing.

Easy to Adjust—Ball bearing adjusting screw; rust proofed steel calibrated springs with full travel in 5 or 10 psi.

Easy to Install—Powers Flowrite V-Port valves have double unions and bronze body with rugged construction to withstand piping strains.

Easy to Service—Valve and top are easy to take apart and re-assemble, facilitating inspection and maintenance.

Reasonably priced. Contact our nearest office for prices and assistance in selecting proper size valves

THE POWERS REGULATOR CO.

SKOKIE, ILLINOIS • Offices in Over 50 Cities

Chicago 13, Ill., 3819 N. Ashland Ave. • New York 17, N. Y., 231 E. 46th Street
Los Angeles 5, Cal., 1808 West 8th Street • Toronto, Ontario, 195 Spadina Ave.
Mexico, D. F., Apartado 63 Bis. • Honolulu 3, H. I., P. O. 2755—450 Piikoi at Kona

OVER 60 YEARS OF TEMPERATURE AND HUMIDITY CONTROL

(a70)

New!

*Look what Powers has done to **Modernize** Control Valves*

Powers NO-PAK Valves Banish Packing Maintenance
Prevent leakage of water or steam or loss of vacuum

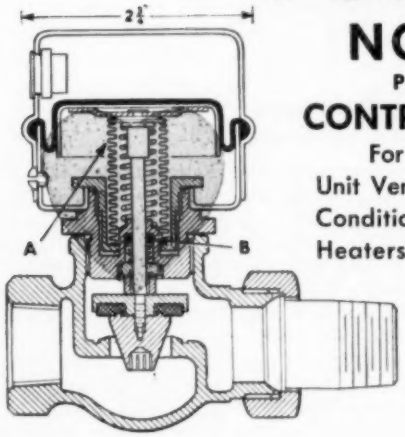
POWERS

NO-PAK

Pneumatic

CONTROL VALVES

For Convectors, Unit Ventilators, Unit Air Conditioners, Baseboard Heaters, Radiators, etc.



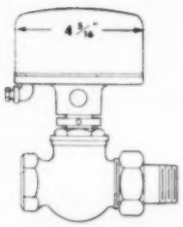
Various Types and Sizes for all requirements

Another POWERS Contribution to Better Heating and Air Conditioning Control

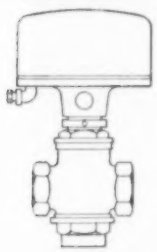
NO-PAK valves with their many advantages are now standard with Powers temperature control systems. Their superior performance is due to Duo-Seal construction.

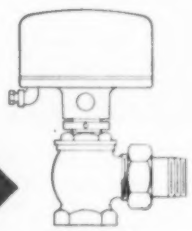
Bronze Packless Bellows (A) in sectional view above, is the primary seal which eliminates packing maintenance — packing friction — steam and water leakage or loss of vacuum. It is designed to withstand pressure up to 150 psi. Maximum valve stroke is only two-thirds of the normal bellows stroke. A spring loaded secondary seal (B) permits servicing of valve top without draining the water system or shutting down the steam heating system. Seal is made of highly elastic neoprene and is ready to act at any time. Small contact between seal and the highly polished stainless steel stem makes friction a negligible factor.

For utmost dependability and lowest cost maintenance specify control by Powers NO-PAK Valves.

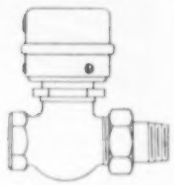


Straightway Union
3-Way Screwed Ends

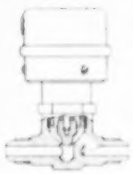




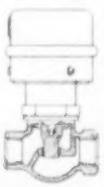
Angle Union

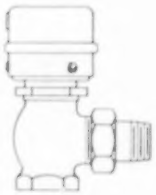


Straightway Union



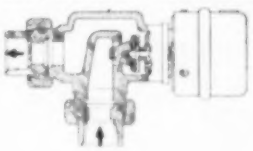
Flared Ends





Angle Union
← Screwed Ends

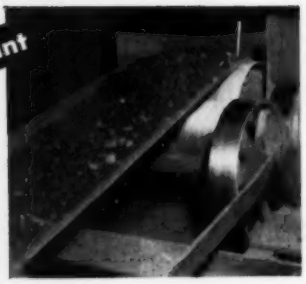
Below: Reverse Flow Double Union



(b2)

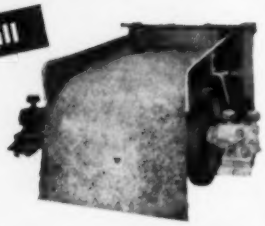
Here's How
DINGS MAGNETS
PROTECT equipment

in a POWER plant



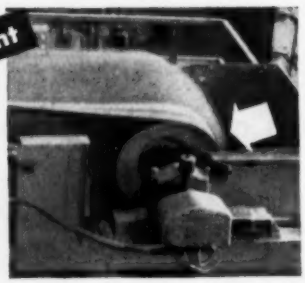
THIS powerful Dings Perma-Pulley removes and discharges 20-25 pounds of tramp iron daily from a belt feeding a coal pulverizer in a Dubuque, Iowa, power station . . . iron damage to the pulverizer has been sharply reduced.

in a GRAIN mill



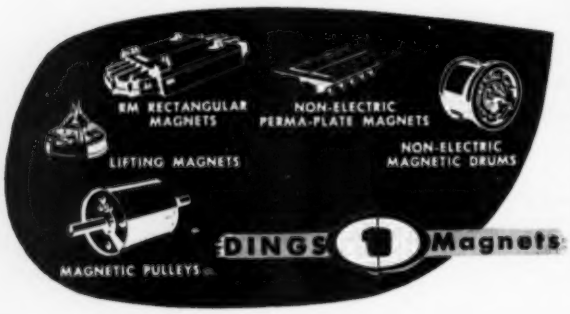
A DINGS magnetic pulley on a job like this not only protects processing equipment, but can also be an important safety factor — sparking tramp iron in a dust laden atmosphere can cause a serious explosion.

in an ORE PREPARATION plant



THIS molybdenum ore processor has just about eliminated down-time on his crusher line by installing Dings Electro-Pulleys — the most powerful made — as head pulleys on conveyors feeding crushers.

WHEREVER, whatever the tramp iron problem in your plant there's a Dings Magnet or Magnetic Separator that's the solution. Write Dings Magnetic Separator Co., 4736 W. Electric Ave., Milwaukee 46, Wis., for bulletin C-5000-B, today.



spot news

(Continued from page 128)

A more recent development is an electronic device which is responsive to Freon or other gaseous halogenated compounds. The first of these was a portable unit developed by General Electric Co. This unit is so sensitive that engineers say it can uncover a leak that would let only 1/100 oz of Freon escape in a year.

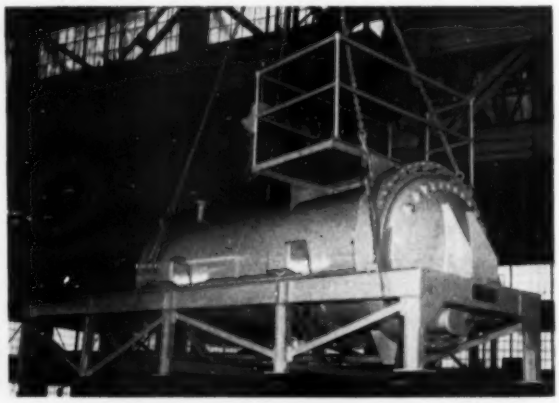
Many applications for the new method have been reported. An important use is in the testing of complicated pipe coils or pressure vessels too large and cumbersome to be filled with compressed air and submerged in a liquid bath, where escaping bubbles would indicate leaks. Foster Wheeler Corp. tests tanks as high as a two-story building by filling them with a mixture of Freon and air and then carefully inspecting likely leak joints, such as fittings or welds, with one of the electronic "noses".

Rare Metal Is Discovered In Bituminous Coal Seams

According to Bituminous Coal Research, there is a new prospecting rush on in the coal mines — for a metal as valuable as gold. The metal is germanium, a very scarce element that has recently gained fame as the basic part of the transistor, the tiny new counterpart of the vacuum tube. Its peculiar electrical properties enable it to conduct electricity either by positive charges or by negative charges, depending on what impurities are added to it.

When the technique of mass producing transistors is perfected, BCR predicts that coal will probably be a major source of the germanium needed. The bottom and top three inches of many bituminous coal seams are rich sources of this rare element. Rich in this case means barely a trace. After these top and bottom three inches are burned under controlled low temperatures, the ashes contain about one-third of one per cent germanium.

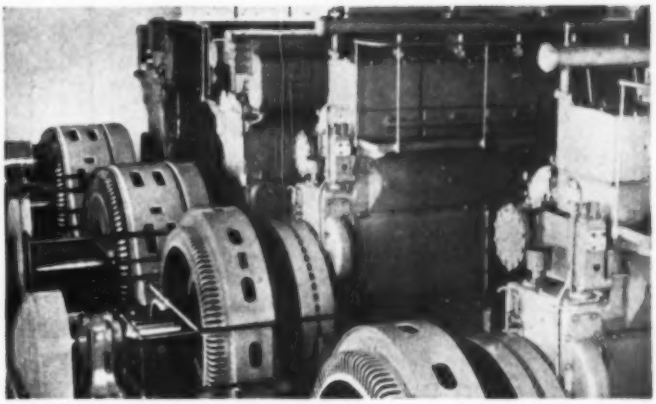
(Continued on page 132)



FILTERS ARE BUILT FOR NEW ALUMINUM PLANT

One of twenty-four retractable shell type pressure filters fabricated by Dravo Corp. for use in a new basic aluminum plant. Developed by H. W. North Co., filters of this design are reported to have wide application for pressure filtration in the chemical, metallurgical and allied industries. The shell is 14 ft long by 5 ft in diameter

"12,000 H.P. Hours per Gallon with Sinclair RUBILENE"



...says Leo D. Bradley, Manager
Western Michigan Electric Co-operative, Scottville, Michigan

"Our two Cooper Bessemer super-charged 1600 H.P. Model LS8T diesels deliver over 12,000 H.P. Hours per gallon of Sinclair RUBILENE H.D. Oil consumed," says Leo D. Bradley.

"We give much of the credit to the quality of this oil," continues Mr. Bradley. "RUBILENE® keeps our diesels exceptionally clean. Wear is kept at a minimum – the result is high efficiency... low operating costs... and low maintenance cost."

Sinclair Products have been used since the generating station first went into operation – 12 years ago. The recommendations made by a Sinclair Lubrication Engineer at that time plus continuous counseling service and superior Sinclair Products have meant substantial savings for this co-operative.

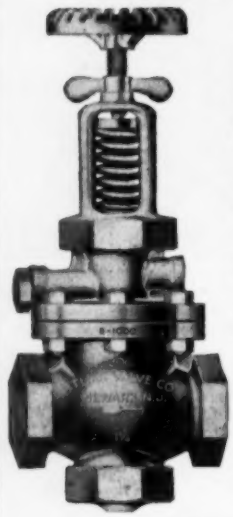
Perhaps a Sinclair Lubrication Engineer can help solve some of your lubrication problems. Phone your local Sinclair Representative or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS
prolong engine life

STELLITED

ATLAS

Steam Reducing Valves Type "B"



In our 52-page bulletin 1-A ten pages are devoted to ATLAS Type "B" Reducing Valves. Fig 112, shown here, is a bronze body reducing valve for 300 pounds steam service. For reduced working pressures from 10 lb. to within 20 pounds of the initial pressure in one stage.

Fig. 114 has an iron body. For initial working pressures from 20 to 250 lb. saturated steam. Reduced: same as Fig. 112.

Fig. 112 (LP) is similar in most ways to Fig. 112 but handles reduced working pressures of ½ to 15 lb.

Fig. 114 (LP) has an iron body. Similar to Fig. 114 but handles reduced working pressures of ½ to 15 lb.

Then come the steel bodies — right from Series 15 to Series 90, for all the way up to 900 lb pressure with 900° F temperature. Some of them handle reduced working pressures from 10 lb. to within 30 pounds of the initial pressure in one stage and the others handle reduced working pressures from ½ lb. to 15 lb.

ALL ARE STELLITED

The pilot valves are solid Stellite. The pilot valve seats are Stellite faced. In the steel body valves the main valve seat is solid Stellite. Stellite assures long life because it is practically immune to severe abrasion and corrosion.

Type "B" valves are recommended for reducing the pressure of steam where the service demands a tight seating valve and a uniform reduced pressure. Simple to maintain. Main valve and pilot valve are easily removed for cleaning. Entire pilot valve can be lifted out without difficulty.

To get the whole story — cross sectional views — details as to parts — etc. — together with information concerning other ATLAS Reducing Valves for steam, water, air, gas, or oil:-

Ask for Bulletin No. 1-A

ATLAS VALVE COMPANY

REGULATING VALVES FOR EVERY SERVICE

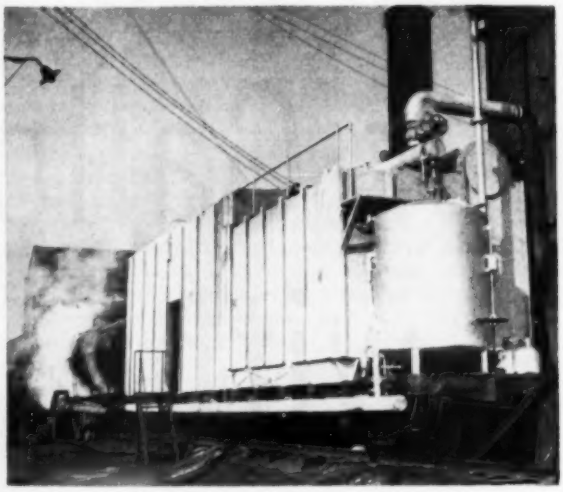
280 SOUTH STREET — NEWARK 5, N. J.

Represented In Principal Cities

Campbell Boiler Feed Regulator
Damper Regulators
Temperature Regulators
Exhaust Control Systems
Back Pressure Valves
Float Valves
Pressure Regulators
Pump Governors
Balanced Valves
Control Valves
Oil Control Cocks

spot news

(Continued from page 130)



Mobile Boiler Plant Supplies Additional Capacity Where Needed

To meet temporary requirements for additional steam capacity due to expanding operations, the engineering department of Publicker Industries, Inc. has designed and built a boiler plant on wheels. The boiler produces 20,000 lb per hr of steam, and the complete unit travels on standard railroad tracks on a flat car supplied by the Pennsylvania Railroad. The railroad's engineers aided in the design so that it would meet specifications of the American Association of Railroads for moving over main line rails.

The boiler is a Babcock and Wilcox standard model with 250 psi maximum pressure. The plant also contains a feedwater heater, pumps, starting gas, a water treating unit, and outside clips for service connections. A 440 v electrical connection is used. At present, the installation is being used to clean tanks, operate steam pumps, and supply heat. Only outside electrical, water, oil, and drain connections have to be changed when the boiler plant is moved. One engineer is required to operate the plant.

High Frequencies Heat Metal for Forgings

Westinghouse Electric Corp. has reported an interesting example of the use of high frequencies to heat metal for forgings. In this particular application it is desired to bring an irregularly shaped billet to 2100 F for forging into gas turbine blades. The billets are about a foot long, weigh about a pound, and are roughly cylindrical except for two ball-like bumps near the center of the bar.

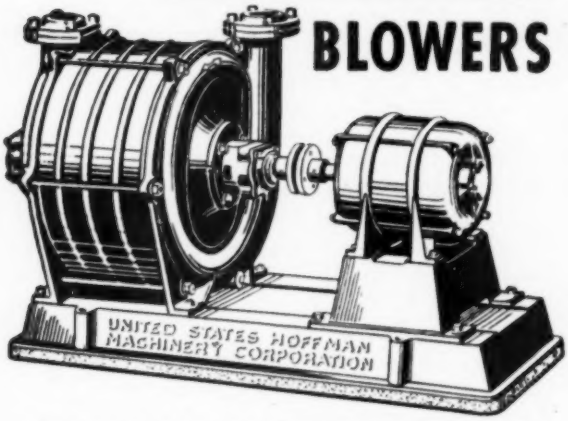
High frequency power for this task is supplied by four 150 kw, 9600 c motor-generator sets, which feed a total of ten work handling machines. A walking-beam and escapement arrangement feeds the billets through the work coil at the rate of one every 15 seconds. Special precautions are taken to prevent billets from contacting the work coil enroute, which would cause a short-circuit. It also was necessary to design a unit that heats the billets without heating the carriage mechanism. An unusually

(Continued on page 134)

When the Process Demands CLEAN, DRY AIR at constant pressure for

- Municipal activated sludge sewage systems
- Industrial activated sludge waste disposal systems
- Agitation of industrial acid neutralization systems
- Oxidation of industrial wastes for disposal
- Removal of cake from continuous filters
- Blow-back cleaning of sediment filter beds

Specify HOFFMAN MULTISTAGE CENTRIFUGAL BLOWERS



DELIVER AIR ENTIRELY FREE FROM ANY OIL, MOISTURE OR VAPORS. POWER INPUT VARIES WITH VOLUME HANDLED

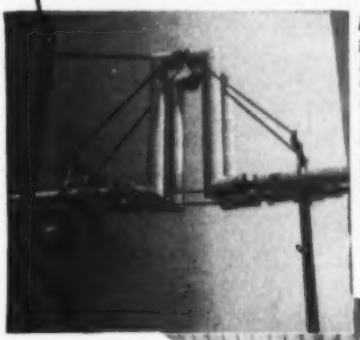
Built for heavy-duty, continuous service . . . no internal moving parts, no internal lubrication to contaminate air. The standard for a variety of applications in paper mills, plating works, steel mills, textile mills, canneries, rubber plants, chemical works and auto plants. Models for a wide range of pressures and volume, for air or gas. Write for Free Bulletin A-650.

HOFFMAN ALSO BUILDS HEAVY-DUTY INDUSTRIAL VACUUM CLEANING EQUIPMENT IN STATIONARY AND PORTABLE TYPES. *Write for Bulletins*

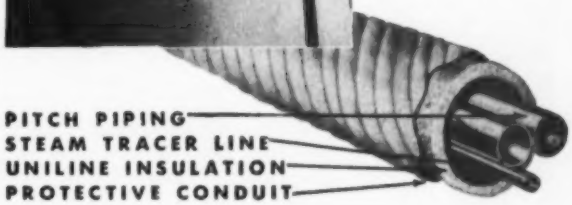
AIR APPLIANCE DIVISION
U.S. HOFFMAN MACHINERY CORPORATION
100 EAST 42nd STREET, NEW YORK 17, N. Y.
CANADIAN PLANT: CANADIAN HOFFMAN MACHINERY CO., LTD., NEWMARKET, ONT.

PIPING VISCOUS MATERIALS?

HERE'S HOW A Large Primary Aluminum Producer Solved Pitch Flow Problem with RIC-WIL UNILINE INSULATED PIPING



Design requirements for this overhead pitch handling system called for an insulated pipe conduit capable of heating the pitch from its solid state at 25° F to a minimum pumping temperature of 285° F. and maintaining this temperature.



THE temperatures required are efficiently maintained in Ric-wiL's Uniline System. Pitch piping is nested with a steam tracer line inside an insulation liner which insulates the pipes from the exterior but not from each other. The emission of heat from the steam tracer keeps the pitch in a free-flowing liquid state and at the desired temperature. The entire system is housed within a protective conduit of 16-gauge Armco ingot iron, helically-corrugated and hot-dipped galvanized.

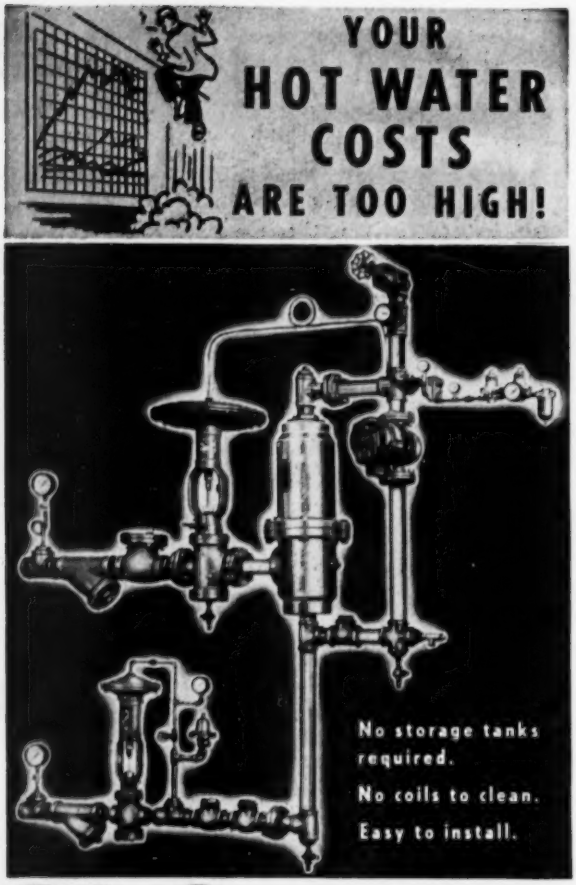
Ric-wiL Uniline Systems are also used to maintain proper flow in piping oil, asphalt, molasses, and many other viscous materials — underground or overhead. Pipe lines subject to corrosive conditions may be coated with Ricwilite, a baked-on phenolic resin having outstanding corrosion resistance and durability.

Scientific design of Ric-wiL Insulated Piping, completely prefabricated with all accessories required, assures high thermal efficiency and speedy, low-cost installation.

- *Write for our latest catalog, or contact us for full technical information on Ric-wiL as applied to your piping problem.*

THE RIC-WIL COMPANY
Mfgrs. Insulated Piping and Conduit Systems
UNION COMMERCE BLDG. • CLEVELAND, OHIO

LEADERS IN INSULATED PIPING PROTECTION



Pick INSTANTANEOUS WATER HEATERS

Eliminate

Excessive Fuel Costs!
Unnecessary Maintenance!
Wasted Floor Space!
Fluctuating Temperatures!

Anxious to reduce operating costs? What about hot water — it's a big item? PICK Engineers are ready to help you save money on hot water required for any industrial need — processing, showers, washrooms, lab, truck washing, etc. PICK Heaters provide hot water INSTANTLY — by quiet steam injection. No waste of heat! They're entirely automatic to provide and accurately maintain temperatures up to 180° F. No storage tanks required. Easily installed in corners, on walls or overhead. Available in seven sizes with rated capacities of 10 to 300 gallons per minute at 140° F. temperature rise. Greater volumes can be obtained with multiple installations.

Write Dept. IP4 for Engineering Details and Specifications

In Daily Use in These Plants:

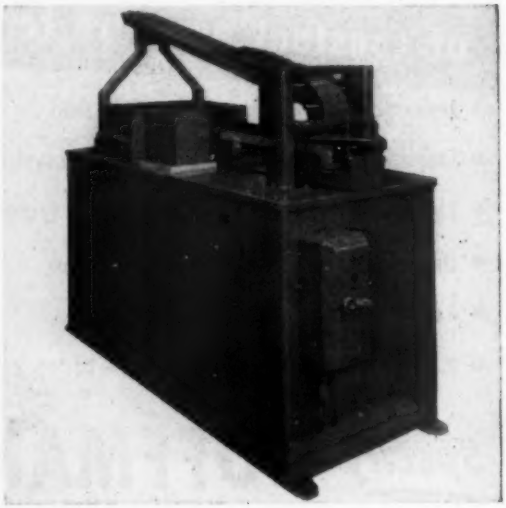
United States Steel Co.
Ford Motor Co.
H. J. Heinz
Bethlehem Steel Corp.
National Dairies
Wilson & Co.

AND MANY OTHERS!

MANUFACTURED BY
PICK MANUFACTURING CO.
WEST BEND, WISCONSIN, U.S.A.

spot news

(Continued from page 132)



shaped carrier was developed in which two sets of currents are induced in opposite phase, thus nullifying each other. It also is made of thin metal to reduce the heat induced in it at these comparatively low frequencies.

Traveling Clinic Will Discuss Local Handling Problems

To promote a better understanding of the correct application of material handling equipment, the American Material Handling Society has decided to conduct a traveling clinic to discuss local problems.

Each of several traveling groups, which will meet requests from local AMHS chapters, will be headed by an officer of The Materials Handling Institute, Inc., and will be accompanied by qualified specialists in the various types of problems. Engineers present at the meetings will be given the opportunity to outline specific problems for analysis by the panel. The groups will begin traveling this spring and will continue throughout the year.

Engineer Emphasizes Importance of Equipment Grounding in Industrial Plants

Adequate grounding of equipment that might come into contact with electric current "is one of the most important factors in safety to personnel in industrial plants."

This warning was contained in a paper presented by L. G. Carpenter, General Electric Co., at a recent meeting of the American Institute of Electrical Engineers. He defined equipment grounding as "connecting to ground of non-current carrying metal parts of the wiring system or apparatus connected to the system.

To indicate the seriousness of the problem, Carpenter cited that 117 injuries, including one death, resulted from contact with ungrounded equipment in California in 1951. By projection, he calculated that there were 1710 such injuries and 14.6 deaths throughout the country.

—End

Facts prove the economy of RUST-OLEUM®

Apply Directly Over Sound Rusted Surfaces

Just scrape and wirebrush to remove rust scale and loose particles — then brush Rust-Oleum 769 Damp-Proof Red Primer *directly over sound rusted surface.*

Lasts Longer Applied Directly Over Rust

Sandblasting, chemical pre-cleaning and other costly preparation methods are *not* usually required. Rust-Oleum penetrates the rust to bare metal, incorporating the rust particles into the coating.

Many Colors, Including Aluminum, and White

Rust-Oleum finish coatings incorporate the same basic rust-inhibiting vehicle as Rust-Oleum 769 Damp-Proof Red Primer. They provide *double protection* and enable you to *beautify as you protect.*

Practical Answer to Your Rust-Producing Conditions

Rust-Oleum resists rain, snow, heat, fumes, sun, salt water, and chemicals. So easy to use by brush, dip, or spray that one man often does the work of two.

Proved Throughout Industry for Over 25 Years

Indoors and out, Rust-Oleum has *proved its capacity to stop rust!* Rust-Oleum can do the same for your tanks, metal sash, stacks, girders, roofs, buildings, machinery, pipes, etc.

An Exclusive Formula

Rust-Oleum is *distinctive* as your fingerprint. It incorporates a specially-processed fish oil vehicle that *dries,* is *odor-free,* and is formulated in *many colors.* Specify Rust-Oleum — accept no substitutes.

There Is Only One Rust-Oleum

RUST-OLEUM STOPS RUST!

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news

of men and companies

ANNOUNCEMENTS

Golden-Anderson Valve Specialty Co.—Has acquired the shop and equipment of Imperial Machine Works, Inc. The increased production facilities of this new addition contain over 20,000 sq ft of usable floor space.

Iron Fireman Mfg. Co.—What has been known as the Heating Control Div. is now designated the Electronics Div. The new name was selected to eliminate local confusion with other Iron Fireman operations and to reflect an expansion into components for electronics systems and other types of electrical instruments.

Owens-Illinois Glass Co.—Effective immediately the name of the Kaylo Div. roof deck material is changed from Kaylo Insulating Roof Tile to Kaylo Roof Deck. There is no change in the product.

EXPANSIONS

Ford Motor Co.—Announces purchase of 160-acre site for $35 to $50 million assembly plant at San Jose, Calif. Construction starts immediately.

Reuland Electric Co.—Negotiations for the purchase of a 12-acre factory site between Detroit and Lansing, Mich. have been completed. Construction is scheduled to start early this spring. Eastern operations will be headed by A. G. Fournier, general sales mgr.

NEW REPRESENTATIVES

Atlas Chain and Manufacturing Co.—Appoints Warren M. Pike Associates, Inc., 274 Franklin St., Boston 10, Mass., as master distributors for the metropolitan Boston area.

Farr Co.—Three new representatives are announced: Johnson Filter Sales Co., Cleveland, Ohio; Pittsburgh Air Filter Service Co., Pittsburgh, Penna.; and Air Filter Sales & Service-Detroit, Detroit, Mich.

Fuel Engineering Co.—General Combustion Co. is the new district representative covering the states of Alabama and Northwestern Florida. F. Matzek and C. Herron, with offices at 399 Brown Marx Building, Birmingham 3, Ala. will handle sales and service for the complete line.

Pennsylvania Crusher Co.—Announces appointment of The Mine and Smelter Supply Co., 1422 17th St., Denver 17, Col., and 1515 11th St., El Paso, Texas, as representatives in New Mexico, Arizona, Western Texas, Colorado, Western Kansas, Nebraska, and South Dakota, and Eastern Wyoming and Montana. Also appointed are The Alliger and Sears Co., 2203 Fannin St., Houston, Texas, in Central and Eastern Texas and Southern Louisiana; and the Tampa Armature Works, Inc., 401 S. Morgan St., Tampa 1, Florida, in Florida and Southern Georgia.

SALES OFFICES

The Hammel-Dahl Co.—Announces the opening of two sales and service offices in California. Both offices are under the supervision of Thomas H. Ponton. The Los Angeles office is at 3715 Santa Fe Ave. and in San Francisco, 607 Market St.

Whiting Corp.—Removal of the St. Louis district sales office from 3238 Olive St. to 567 North and South Road, University City 5, Missouri is announced.

New engineering building of Edward Valves, Inc. Modern stainless steel and glass structure, specially designed for greatest efficiency of engineering dept, includes large drafting room with maximum natural north light

American Institute of Electrical Engineers—More than 4,500 attended the winter general meeting, largest since the institute was founded. Shown above are, left to right, Dr. H. T. Heald, Chancellor of New York University, who gave the keynote address; D. A. Quarles, president of the institute and H. H. Henline, institute secretary

ANNIVERSARIES

The Goodyear Tire and Rubber Co.—The 40th anniversary of the mechanical goods division was reached Feb. 1, 1953

APPOINTMENTS

The American Brass Co.—A. B. Freeman is appointed v-p of The American Metal Hose Branch.

Anaconda Wire & Cable Co.—R. A. DeMatteo, 2nd, salesman in the Washington district sales office for the last several months, is transferred to the New York office. J. P. Ruch, salesman in the Kansas City office, is moved to the Detroit office. B. Van Wagner rejoined the sales organization, and is assigned to the New York district office.

Bailey Meter Co.—G. M. Wallace, mgr of the Denver district, is promoted to an asst sales mgr with headquarters in Cleveland. He will supervise the sale of meters and control equipment to the process industries. A. L. Danielson succeeds Wallace as manager of the Denver branch office.

Beckman Instruments, Inc.—Appointment of J. D. Wilkinson as mgr, market research div., is announced.

BullDog Electric Products Co.—Appoints K. P. Stiner, formerly chief of the electrical bureau of the City of Detroit, as product engineering coordinator.

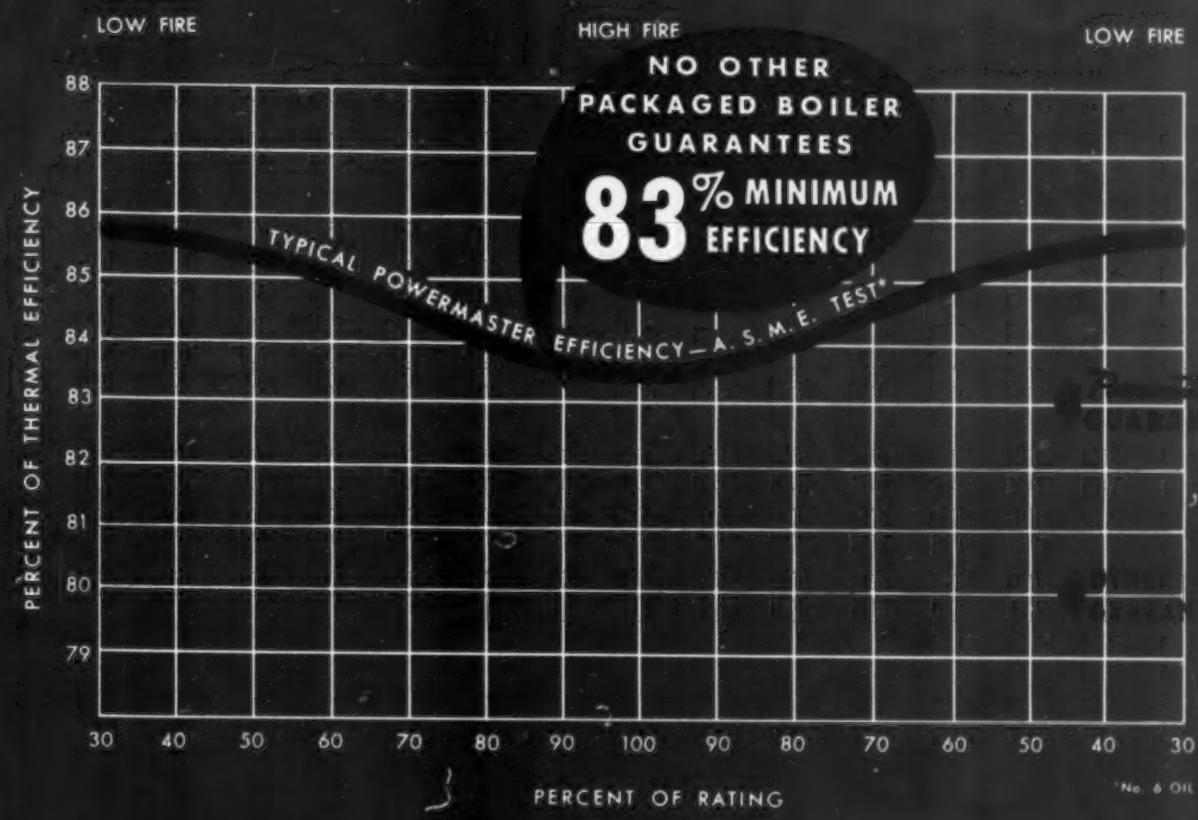
The Colorado Fuel and Iron Corp.—H. C. Allington is elected v-p in charge of sales of the eastern div. L. A. Watts succeeds Allington as general mgr of sales of the eastern div.

Fairbanks Co.—J. L. Ragland is named mgr of the new Rome, Georgia branch.

General Controls Co.—The appointment of D. P. Shafer as mgr of the Columbus, Ohio, branch office is announced. Headquarters of the Columbus operation are at 81 East State St.

Gustin-Bacon Mfg. Co.—B. Gilcrist is advanced to div mgr at Philadelphia with L. E. Feitt, presently resident salesman in Pittsburgh, as assistant. S. S. Burger also will operate from the Philadelphia area as heretofore.

(Continued on page 139)



Only Powermaster guarantees 83%!

The "pay-off" on a boiler is its operating efficiency!

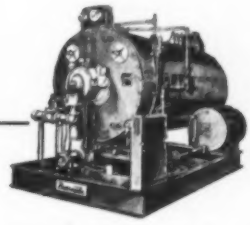
Take a look at this typical efficiency curve of POWERMASTER . . . then compare A.S.M.E. tests with those of any other boiler! At less than full load (which is normal in field operation) notice that POWERMASTER efficiency actually *increases.*

There's a reason for such efficiency. The POWERMASTER is the development of 68 years' experience in boiler manufacture. Continuing research and progressive engineering have consistently been reflected in POWERMASTER design:

- **FIRST to provide the Voriflow air-atomizing burner.**
- **FIRST to provide full modulating cam control.**
- **FIRST to provide immediate change-over from oil to gas firing.**
- **FIRST to provide a *complete* packaged unit.**

Point-by-point, POWERMASTER welcomes comparison. Before deciding on a new boiler for your plant, be sure to get the facts on the new POWERMASTER with VORIFLOW combustion. Just drop us a line and we'll be glad to send you complete information.

Powermaster®
PACKAGED AUTOMATIC BOILERS
In sizes to 500 HP; pressures to 250 psi.

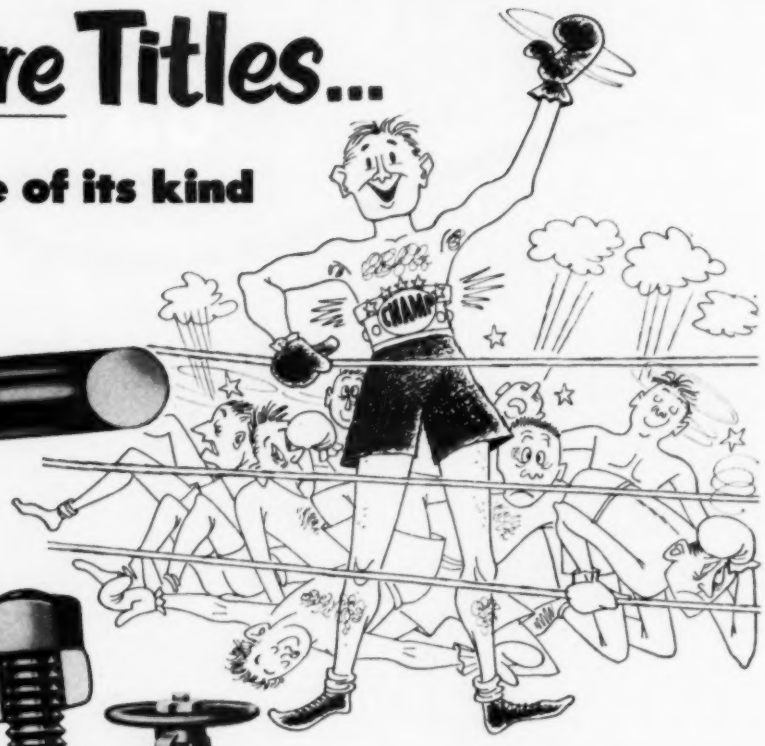


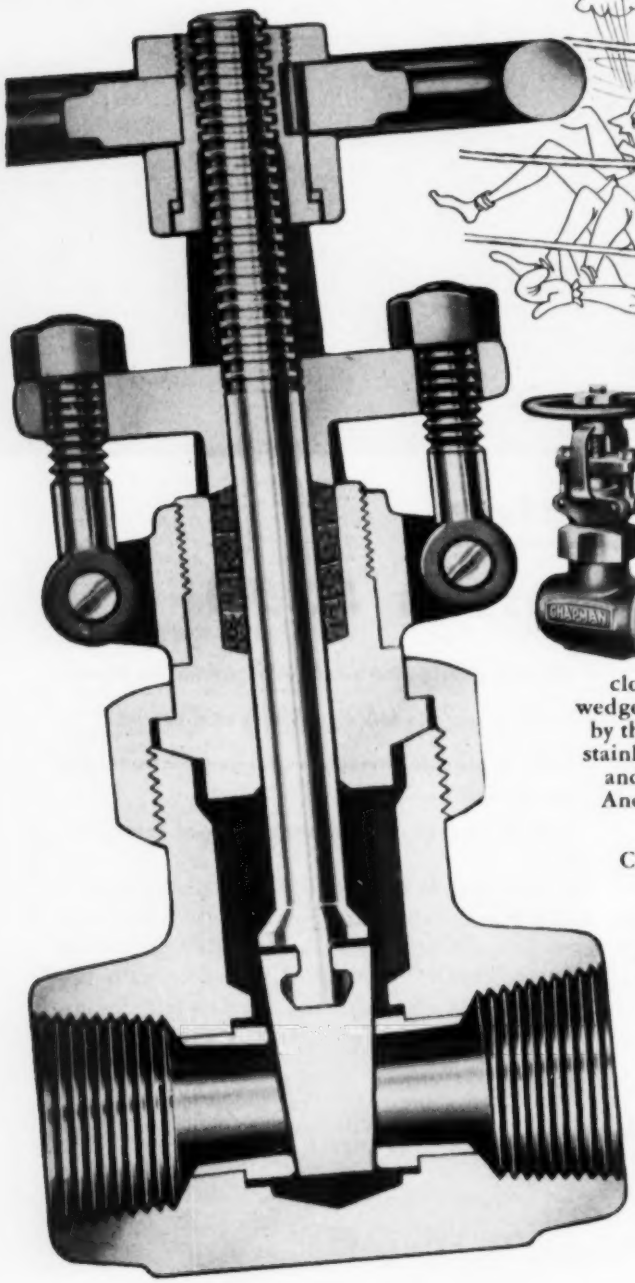
ORR & SEMBOWER, INC. • *Established 1885* • 950 MORGANTOWN ROAD, READING, PENNA.

CHAPMAN LIST 960

Holds More Titles...

than any valve of its kind





Yes, here's the champ of all small forged steel gate valves! It has licked more different jobs than you can shake a stick at . . . and stays in there fighting with all the *extra stamina* you get in *every* Chapman Valve.

Here are the reasons why: Extra protection against even unusual stress when opening and closing the valve is provided by extra-strong stem-and-wedge-gate connection. Repairs and replacements are cut by the use of super-hardened seat rings and gate faces of stainless steel. Forged body and yoke are longer-lived . . . and bolted follower has no threads on yoke to corrode. And lastly, gate faces won't seize or gall because they're *Malcomized* (Chapman patent) to 800 Brinell.

Chapman List 960 Forged Steel Gate Valves are made in sizes from ½″ to 2″ inclusive . . . with rising stem with yoke (shown) or with rising stem with inside screw. Bonnet joints are either gasketed or metal to metal. Pressure range: 2,000 lb. at 100° F. — 380 lb. at 1,000° F. For higher pressures, specify List 990. And for full details on List 960, send today for your copy of Catalog 10.

THE CHAPMAN VALVE MFG. CO.

INDIAN ORCHARD, MASS.

news

of men and companies

(Continued from page 136)

The Electric Products Co.—Dr. W. A. Thomas formerly mgr of electrical engineering is appointed chief engineer. E. D. Smith is now consulting engineer and J. J. Unger becomes mgr of electrical engineering. J. R. Williams, formerly the central planning mgr, is named manufacturing mgr. R. H. Worby is appointed chief industrial engineer.

Allis-Chalmers Manufacturing Co.—Appointment of A. F. Erwin and E. F. Brill as mgr and chief engineer, respec-

tively, of the atomic power section is announced. W. L. Manly, for the last several years special asst to C. W. Schweers, v-p and director of sales General Machinery Div., is named asst director of sales. Five new appointments to engineering posts at the Norwood Works are announced. They are R. G. Bartheld, R. L. McDermott and W. A. Giger, all named application engineers in the electrical section; W. G. Nolte, appointed an asst engineer in the research laboratory, and T. Capizzi, an asst engineer in the plant engineering dept. E. G. Krahn, J. F. Sellers, Jr., and C. J. Krenzer are newly named to posts in sections of the power dept. Krahn is named an asst engineer in the blower and condenser section; Krenzer an application engineer in the water conditioning section. Sellers is appointed an asst engineer in the switchgear section.

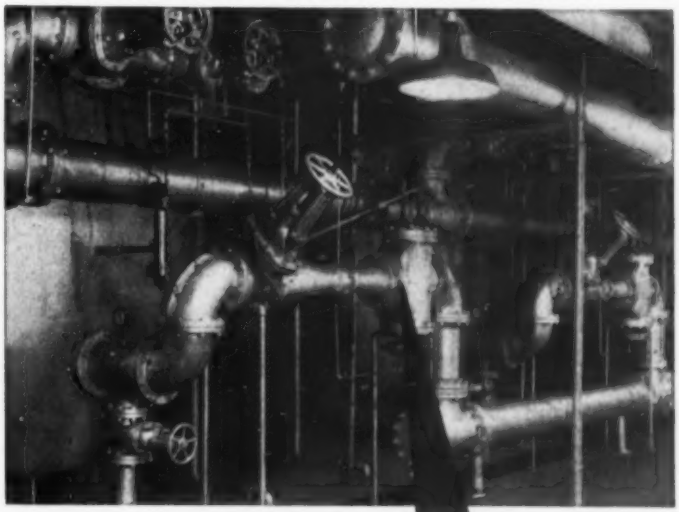
General Electric Co.—Announces that general mgrs of eight operating divisions are elected v-ps by the board of directors. Those elected were: J. M. Crawford, genl mgr of the motor and generator div; F. E. Fairman, genl mgr of the transformer and allied products div; C. W. LaPierre, genl mgr of the aircraft gas turbine div; C. H. Linder, genl mgr of the major appliance div; H. A. MacKinnon, genl mgr of the component products div; C. K. Rieger, genl mgr of the small appliance div; G. B. Warren, genl mgr of the turbine div; and W. C. Wichman, genl mgr of the industrial power components div. T. J. Marshall and K. W. Macdonald are appointed Construction Materials Div. district representatives. Marshall is assigned to handle accessory equipment products in the North Central district. His office will be at 5726 West 51st St., Chicago. Macdonald will handle the full line in the Columbus trading area.

(Continued on page 140)

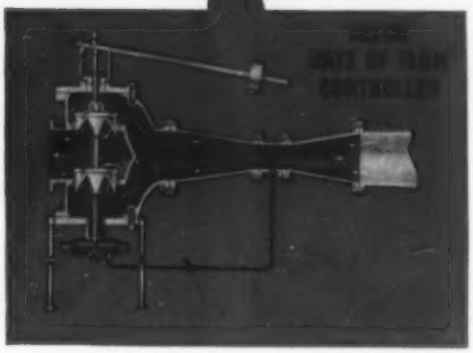
PROCESSES FOR REMOVAL OF WATER IMPURITIES

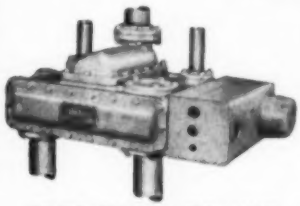
BELCO horizontal filters provide low cost treated water

INCORPORATE AUTOMATIC BELCO RATE OF FLOW CONTROLLERS FOR OPTIMUM CONTROL



Belco provides automatic or manual filtration equipment for any flow capacity. The experience of Belco engineers in process control is unmatched. The Belco Rate of Flow Controller insures constant rate of flow under varying pressure conditions. The unit is sensitive, accurate and designed for low head loss. More information? Ask the Belco man!





BELCO CAMOMATIC VALVE

BELCO AUTOMATIC CONTROL PANELS

For Automatic Control of processes in all industries.

Belco process control know-how is unmatched. You'll find Belco equipment saving money in many prominent plants. Ask your Belco representative how you too can save money, automatically.

★We invite your consultation regarding all water conditioning requirements. Get acquainted with our organization for authoritative assistance and close cooperation. Write for late descriptive bulletins.

Belco

Belco Industrial Equipment Division, Inc.

PATERSON 3, NEW JERSEY

Steam Production News

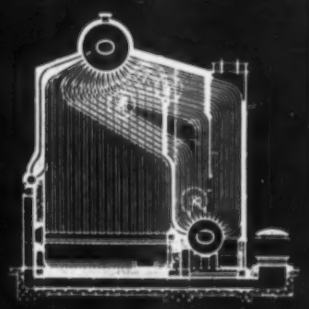
MODERNIZATION AT WALTER REED GENERAL HOSPITAL FEATURES TYPE K-

BIGELOW

Two Type K Boilers By Bigelow provide up-to-date steam production in the recently modernized heating plant of the Army Medical Center, Walter Reed General Hospital, Washington, D. C.

Each boiler has a capacity of 75,000 lbs. of steam per hour — continuous and 82,500 lbs. of steam per hour for 4 hour peaks. Both boilers are oil-fired with four burners per boiler. Combustion control equipment is mounted on a central panel serving both boilers.

The boilers are built and installed in accordance with specifications of The Corps of Engineers U. S. Army. The mechanical contractor was Harry E. Nau & Co., Inc., Washington, D. C.



BOILERS BY BIGELOW

THE BIGELOW COMPANY • NEW HAVEN 3, CONN.
Established 1833

BIGELOW REPRESENTATIVES: Boston • New York • Chicago • Philadelphia • Syracuse • Detroit • Atlanta • Milwaukee • New Orleans • Petersburg, Va. • Washington, D. C. • San Francisco • Los Angeles • Seattle • Knoxville

news

of men and companies

(Continued from page 139)

Honan-Crane Corp.—The appointment of E. A. Warren, formerly associated with Bowser, Inc., to the sales engineering staff is announced. He will cover southern Indiana, southeast Illinois and northwest Kentucky, with headquarters in Princeton, Ind.

Illinois Engineering Co.—Announces the retirement of J. C. Matchett as president, and the re-election of R. L. Gifford, a co-founder of the company, as president. G. L. Harris, v-p, has been elected general manager.

Koppers Company, Inc.—J. N. Moore, Jr., is named sales engineer in the Chicago district office of the Metal Products Div. J. W. Freund, sales engineer of the piston ring dept since 1951, is now Detroit sales engineer for the entire Metal Products Div.

Builders Iron Foundry—E. H. Bradley, newly-elected president, announces that G. W. Kelsey was elected president

E. H. Bradley G. W. Kelsey

of Builders-Providence, Inc. at the recent directors meeting. BPI is the instrument div. of Builders Iron Foundry

General Electric Co.—L. D. Whitescarver assumes the post of mgr of marketing for the medium steam turbine, generator and gear dept. R. B Elmendorf, former Washington, D. C district representative, is appointed mgr-marketing for the Construction Materials conduit products dept. New district representaive for Construction Materials Southwestern district is E. R. Robbins. His office will be at 418 Terminal Building, Oklahoma City, Oklahoma. Another new Construction Materials Div. district representative appointment is H. L. Cahan. He will be responsible for the wire and cable department's products in the Los Angeles area with offices at 3000 East 46th Street.

Square D Co.—Appointment of D Miller as district mgr of the Northwest territory is announced. Replacing Miller as industrial control sales mgr is R L. Russell, former Los Angeles territory sales supervisor. New district engineer for the Pacific Northwest is E. R. Walton.

(Continued on page 142)

any way you look at it...

Superwashed

COALS ARE BEST!

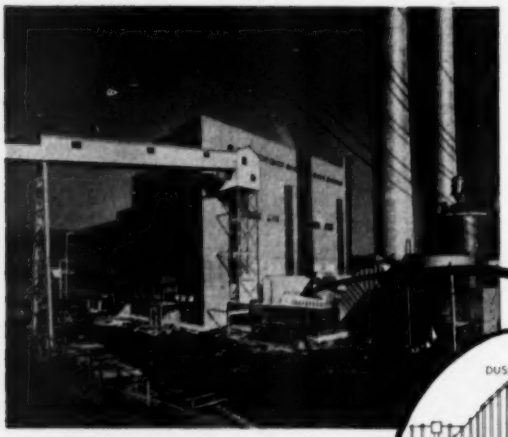
From any angle, Bell & Zoller's *Superwashed* coals are best for keeping boiler efficiency up . . . steam costs down. Scientifically cleaned and correctly processed, the *right* coal for your burning equipment can be shipped via rail or economical rail-water routes from Kentucky, West Virginia, Indiana or Illinois.

BELL & ZOLLER COAL COMPANY

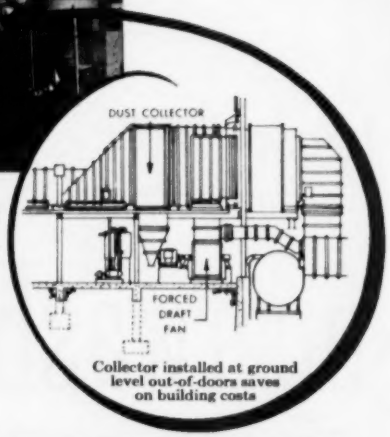
Bell Building • Chicago 1, Illinois

Zeigler • Oriole • Moss Hill • Murdock • Buckhorn
Spring Hill • Vesta Red Ash • Otter Creek

SIXTY-SEVEN YEARS OF SERVICE TO COAL USERS • ST. LOUIS • LOUISVILLE • OMAHA • MINNEAPOLIS • TERRE HAUTE



Titus Station
Metropolitan Edison Co.
Reading, Pa.



Collector installed at ground level out-of-doors saves on building costs

Answer *your* specific dust control problems with an

AEROTEC

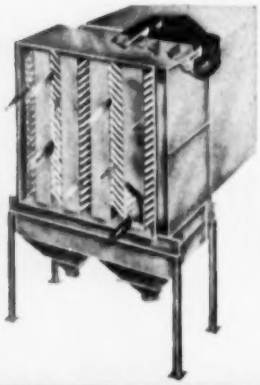
DUST COLLECTOR
exactly tailored to your needs

Here is one of the many instances in which the Aerotec Design 3 RAS Dust Collector proved its high efficiency so conclusively that Metropolitan Edison purchased a third unit. Gilbert Associates Inc., of Reading, Pa., were designers and constructors. Three bituminous coal-fired steam generators at this modern power plant, will be equipped with Aerotec Collectors. Layout and breeching are so designed that an Aerotec electrical secondary can be added at a future date without loss of the initial investment.

This mechanical collector, with its multiple, small-diameter tubes, offers you the advantages of high dust recovery in the ultra-fine ranges, even at partial load. The tubes are permanent mold aluminum castings of absolute uniformity. This construction provides the smooth inner wall necessary to ultra-fine dust collection. Tubes are assembled at the factory in lightweight "building block" sections. These assemblies permit flexible arrangement to suit your needs, with the economy of standard construction.

Let our engineers bring to your problems the benefits of their long experience in the field of flyash collection. No obligation.

Typical Inlet and Outlet Variations



Catalog 601 gives you complete details on standard and special Aerotec arrangements, plus other useful data on dust collection. Call or write for your copy today.

Project Engineers

THE THERMIX CORPORATION
GREENWICH, CONN.
(Offices in 38 Principal Cities)

Canadian Affiliates: T. C. CHOWN, LTD.
Montreal 25, Quebec — Toronto 5, Ontario

THE AEROTEC CORPORATION
GREENWICH, CONN.

news
of men and companies

(Continued from page 140)

The B. F. Goodrich Co.—A. Kelly, genl mgr of industrial and aeronautical products manufacturing assumes the position of v-p-manufacturing. T. G. Graham, v-p since 1928, retired after more than 28 years' service. R. G. Cox becomes eastern div mgr with responsibility for all activities in the Boston, New York, Philadelphia, Akron, Detroit and Chicago districts. I. N. Kimsey is named western div mgr with responsibility for Los Angeles, San Francisco, Seattle, Denver, Kansas City, Dallas and Atlanta.

Gould-National Batteries, Inc.—W. H. Burkey of the Industrial Div. sales staff in St. Louis, Missouri, is promoted to district mgr in that area.

Dearborn Chemical Co.—R. F. Carr, Jr., who was recently elected v-p, has joined the sales organization in Chicago, and is presently working with the heads of the industrial and railroad depts to promote the general sales of company products.

R. F. Carr, Jr. — Dr. R. C. Ulmer

Combustion Engineering-Superheater, Inc.—Dr. R. C. Ulmer, well known in the power field as a feedwater specialist and for the last seven years technical director of E. F. Drew & Co., joined the engineering dept where he will be engaged in development work.

Minneapolis-Honeywell Regulator Co.—G. E. Seidel is elected a v-p in charge of engineering in the company's Minneapolis plants. O. B. Wilson is named industrial instruments sales mgr for the industrial div.

Monsanto Chemical Co.—R. C. Thumser, plant engineer of the John F. Queeny plant, is named to the new position of co-ordinator of standards of the general engineering dept. In the new post, he will be concerned with the development of a company-wide system for promulgation of standards for engineering and procurement. W. E. Chandler, plant engineer at the Nitro, W. Pa. plant, succeeds Thumser as plant engineer at the John F. Queeny plant in St. Louis. T. M. Morrow, area engineer at the John F. Queeny plant, takes Chandler's place at the Nitro plant.

(Continued on page 144)

Corrosion of piping in steam and condensate return lines is an expensive two-way headache. (1) It leads to large outlays for pipe replacement and maintenance. (2) It often results in plugged return lines and traps due to the solid products of corrosion. Bird-Archer Amine Treatment effectively eliminates these troubles at low cost.

Here's how. Amines are fed into the boiler or into the steam and condensate systems. The amines raise the pH value of the condensate and also tend to inhibit equipment-destroying corrosion through surface protection of the metal itself. In scores of plants, this Bird-Archer system has more than paid for itself by substantially cutting replacement and maintenance costs.

Bulletin CP 100 gives all the facts on Bird-Archer Amine Treatment. Write for your copy.

BIRD-ARCHER
WATER TREATMENT

THE BIRD-ARCHER COMPANY, 4337 NORTH AMERICAN ST., PHILADELPHIA 40, PA.
NEW YORK • CHICAGO

IN CANADA: The Bird-Archer Co., Limited, Cobourg, Ontario
In Mexico: Calderas y Accesorios, S.A., Amsterdam 291, Mexico, D.F

BA 108

If your process requires the valving of "hard-to-handle" fluids . . .

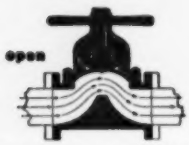
Leakproof valving of air . . . corrosive materials . . . slurries . . . solids . . . volatile and viscous substances

Hills-McCanna Diaphragm Valves can eliminate the problems involved in valving many of the so-called "hard-to-handle" fluids. By employing a simple pinch clamp principle, Hills-McCanna valves put an end to leakage, repacking and contamination.

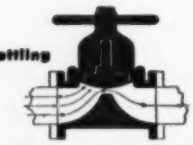
Hills-McCanna Valves are available handwheel or lever operated or for operation by pneumatic or hydraulic cylinders, diaphragm motors, electric motors, etc. Choice of 14 diaphragm materials, 49 body materials. Sizes from ⅜" to 14". Suitable for pressures to 150 psi., temperatures to 180° F. (higher with special materials). Screwed or flanged connections.

Write for Catalog V-52, HILLS-McCANNA CO., 2355 W. Nelson St., Chicago 18, Ill.

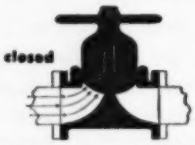
THIS SIMPLE PRINCIPLE ASSURES POSITIVE LEAK TIGHT VALVING



Compressor is raised, lifting diaphragm by means of a stud molded into the material.



Compressor and diaphragm partially lowered. Compressor design guides and supports diaphragm.



Compressor presses diaphragm tightly against weir, pinching off flow and making a tight seal.

HILLS-McCANNA

saunders patent diaphragm valves

Also Manufacturers of Proportioning Pumps Force Feed Lubricators • Magnesium Alloy Castings

news

of men and companies

(Continued from page 142)

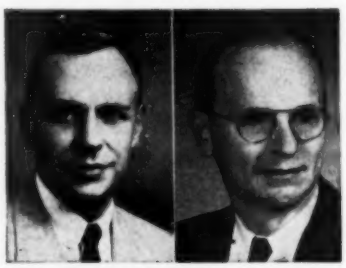
Kuhlman Electric Co.—Announces the addition of C. R. Kirkbride to the engineering staff. He will act as administrative assistant to A. V. Hughes, director of engineering.

Minneapolis-Honeywell Regulator Co.—J. A. Robinson is made field sales mgr of industrial instruments. F. Day, V. Lo Scalzo and V. L. Evans are assigned to field sales posts for the Valve Div. Day handles industrial valve sales in the New Orleans area, Lo Scalzo in Kansas City, Mo., and Evans in Wilmington, Delaware. D. W. Fryback is named sales mgr of the Eastern region for the Industrial Div. Appointment of O.B. Pyle, Jr. as industrial mgr of the Mid-Atlantic area and E. J. Klein as industrial mgr for the Philadelphia branch office also is announced.

D. J. Murray Manufacturing Co.—L. H. Lemke is named general supt. He was formerly supt of the machine shop.

Riley Stoker Corp.—R. A. Banck, formerly chief engineer with Bigelow-Liptak Corp., is appointed district mgr of the New Orleans territory. He fills vacancy left by the late Clyde Beatty.

De Laval Steam Turbine Co.—L. P. Mellgren, formerly sales engineer with Detroit Stoker Co., heads the new district offices in the Northwestern Bank Bldg., Minneapolis, Minn.



L. P. Mellgren **Dr. C. G. Veinott**

Reliance Electric & Engineering Co.—Dr. C. G. Veinott, well known electric motor design engineer, inventor and author, has joined the company as consulting engineer on a-c machinery.

Taylor Instrument Companies—R. E. Clarridge becomes chief engineer replacing K. H. Hubbard who was made technical director. Hubbard is also a member of the board of directors. Replacing Clarridge as mgr of the application engineering dept is G. E. Howard, formerly asst mgr. Other changes involve R. D. Thompson, named div head in charge of research, design, methods and technical sales in the glass products div; L. C. Liberatore, D. W. Shepardson and J. R. Davidson, all made engineering section heads.

The Weinman Pump Mfg. Co.—At the annual stockholders meeting D. G. Lear, formerly chief engineer and v-p, was elected president and genl mgr to succeed P. W. Holstein, Sr., who is retiring from active management but will continue to serve as chairman of the board of directors. Dr. L. K. Herndon will serve as v-p and treasurer, and G. A. Shonting is the secretary. H. R. Michener, previously with the Foster Wheeler Corp., succeeds Lear as chief engineer.

Westinghouse Electric Corp.—P. C. Smith, newly named manager of the Transportation and Generator Div. at East Pittsburgh, Pa., appointed W. R. Sugg, Jr. asst mgr of the div., and G. A. Moore mgr of manufacturing. C. B. Dick is appointed mgr of the Micarta Div., succeeding E. R. Perry, who resigned to accept a position with an eastern firm. C. H. Brechin is appointed mgr of the porcelain dept. He assumes the post left vacant by the death of W. F. Bailey.

Schutte and Koerting Co.—U. W. Fischer, formerly v-p, was elected president at a recent meeting of the stockholders of the company.

Transicoil Corp.—D. W. Bloser, formerly chief engineer, is named v-p.

The Trane Co.—G. A. Ellis is appointed to the products engineering dept.

Servo-Tek Products Co.—Names C. C. Honeywell chief engineer.

Black, Sivalls & Bryson, Inc.—New general mgr of engineering is C. A. Siver.

OBITUARIES

C. H. Currier, 66, chairman of the board of Kewanee-Ross Corporation, died suddenly on December 22, in Buffalo, N. Y.

C. H. Currier **F. M. Mason**

F. M. Mason, 42, v-p of U. S. Electrical Motors Inc., passed away December 27 of a heart attack. He was genl mgr of the company's Atlantic plant in Milford, Connecticut.

George R. Weber, v-p, treasurer and a director of Raybestos-Manhattan, Inc., and genl mgr of its U. S. Asbestos Div. plant at Manheim, Pa., died recently at his home in Lancaster, Pa.

ANNOUNCEMENTS

Strong, Carlisle and Hammond Co.—Is appointed national distributor for the new Borgana boiler water treatment. This product is a liquid extracted from red cedar wood by a complex process and was developed over the last ten years by the Chemical Div. of The Portland Shingle Company. To meet the growing demand for the product the national distributor plans to appoint some 200 distributors to handle Borgana.

Midwest Piping and Supply Co.—Announces name of company changed to Midwest Piping Company, Inc.

International Glass Corp.—Purchased all the plant facilities and equipment of the Perrault Glass Fiber Corp. in Newport, Arkansas. Engineering improvements are being made to the plant which will resume full production in a short time. Executive offices are located at 8715 W. 3rd St., Los Angeles.

Consolidated Engineering Corp.—Formal acquisition of the vacuum equipment department of Eastman Kodak's Distillation Products Industries by Consolidated Engineering Corp. is announced. The new company will operate under the name of Consolidated Vacuum Corporation, a wholly owned subsidiary.

Different?

...Ask:

Cincinnati Gas & Electric • Public Service Co. of Northern Illinois • Commonwealth Edison Co., Calumet Station • Arkansas & Missouri Power Co., Campbell, Mo. • Southwestern Public Service Co., Amarillo, Texas • U. S. Atom Bomb Plant, Oak Ridge

More than 65,000 sq. ft. of Klemp Diamond Riveted Grating at The Cleveland Electric Illuminating Co., Eastlake Plant, Eastlake, Ohio.

As usual...

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Executive Office: 1371 N. Branch Street, Chicago 22, Illinois
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Please substantiate your statement that Klemp Gratings are DIFFERENT.

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HERE'S YOUR *Complete* STEAM PLANT

- One purchase, backed by undivided responsibility.
- Shipped completely assembled after factory tests to assure highest operating efficiency.
- More than 80% thermal efficiency guaranteed.
- 4-pass design provides 5 sq. ft. of heating surface per b.h.p.
- Induced draft fans which are built-in eliminate the need of an expensive chimney.
- Simple installation requires no special foundation.
- Clean, quiet operation.
- Heavy-duty, rugged construction assures long-lived dependability.
- Burner equipment to suit your fuel: gas, oil or both.
- 18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i., or for hot water heating.
- For complete details, write today for catalog 502.

SUPERIOR STEAM GENERATORS

SUPERIOR COMBUSTION INDUSTRIES, Inc.

Factory: Emmaus, Pa.

Executive Offices: Times Building, Times Square, New York 18, N. Y.

3 *special departments featured monthly to give you FREE bulletins, catalogs and product data screened for your personal interest in*

ENGINEERED PLANT SERVICES

1. NEW EQUIPMENT

Begins on page 8

Contains highlights of new products by leading manufacturers, briefed and illustrated for your easy reference. Complete data on each of these products are available **free**.

2. NEW BULLETINS

Begins on page 162

Includes descriptions of only those bulletins and catalogs that are really **new** and of ***direct value*** to you — saves your reading time, yet gives you full service. All bulletins sent to you ***free*** on request.

3. READERS GUIDE TO ADVERTISED PRODUCTS

Begins on page 149

Designed to catalog advertised products for your convenience in finding the ads which are of special interest to you at this time. Also lists those important bulletins, catalogs and working data offered **free** in the advertisements.

REQUEST CARD FOR LITERATURE OR MORE INFORMATION—March, 1953

To: INDUSTRY AND POWER, St. Joseph, Mich. Please have forwarded to me, at no obligation, the literature I've indicated by the following key numbers:

New Equipment begins Page 8	*New Bulletins begins Page 162*	*Advertised Products begins Page 149*
No's	No's	No's

Your Name _____ **Title** _____

Your Company _____

Co. Address (St. & No.) _____

City _____ **State** _____

Inquiries for items in this issue not serviced beyond July 1, 1953

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readers guide

to advertised products

AIR & DUST FILTERS & COLLECTORS

Adv. p 171 contains data on Norblo dust and fume collectors—centrifugal, hydraulic and bag systems. The Northern Blower Co.

Booklet outlines principles of Multiclone centrifugal dust recovery. Western Precipitation Corp. p 157. Key No. **500.**

Booklet F shows typical installations of fume control system. The Kirk & Blum Mfg. Co. p 163. Key No. **501.**

Cat. 601 gives complete data on Aerotec dust collection. The Thermix Corp. p 142. Key No. **502.**

ANTI-CORROSIVE & PROTECTIVE COATINGS

Adv. p 135 contains coupon for complete information on Rust-Oleum sealing compound. Rust-Oleum Corp. Key No. **503.**

BOILERS & BOILER ACCESSORIES

Catalog describes Type K boilers by The Bigelow Company. p 140. Key No. **504.**

Adv. p 41 contains data on Travagrate spreader fired Erie City 3-drum steam generators. Erie City Iron Works.

See adv. p 174 for information on chimneys. Consolidated Chimney Co.

Adv. p 25 offers descriptive literature on complete line of Wickes steam generating equipment. The Wickes Boiler Co.

Free blowdown chart available on Henszey packet-type automatic continuous blowdown. Henszey Co. p 161. Key No. **505.**

Bull WG-1823 contains full information on Yarway liquid level indicator. Yarnall-Waring Co. p 62. Key **506.**

Bull SW-52 contains information on Wing turbine blowers. L. J. Wing Mfg. Co. p 153. Key No. **507.**

BUILDING HEATING, VENTILATING, AIR CONDITIONING & REFRIGERATION

Adv. p 52 contains information on the complete line of Trane matched air conditioning products. The Trane Co.

BUILDING MATERIALS & MAINTENANCE

Free Repair Handbook describes Smooth-On repairs. Smooth-On Mfg. Co. p 180. Key No. **508.**

Free sample and data sheet on Fel-Pro C-5 "Hi-Temp" thread compound. Felt Products Mfg. Co. p 178. Key No. **509.**

Coupon on p 145 offers literature on Klemp diamond riveted grating. Klemp Metal Grating Corp. Key No. **510.**

Bull 2365 contains data on electroforged steel grating. Blaw-Knox Div., Blaw-Knox Co. p 180. Key No. **511.**

Coupon on p 179 offers complete details on trial order plan and Handbook of Building Maintenance. Flexrock Co. Key No. **512.**

COAL, ASH & BULK HANDLING

Bull C-5000-B contains data on Dings magnet or magnetic separator for tramp iron problems. Dings Magnetic Separator Co. p 130. Key No. **513.**

Book 2410 shows latest equipment and system layouts for power plants large and small. Link-Belt Co. p 3.

COMPRESSORS

Bull 3172-A describes I-R XVO diesel-powered compressors. Ingersoll-Rand. p 53. Key No. **514.**

Bulletin contains complete information on Cooper-Bessemer power-driven Type M compressors. The Cooper-Bessemer Corp. p 38. Key No. **515.**

Bull 728 Supplement D gives details on CP oil-less cylinder compressors. Chicago Pneumatic Tool Co. p 46. Key No. **516.**

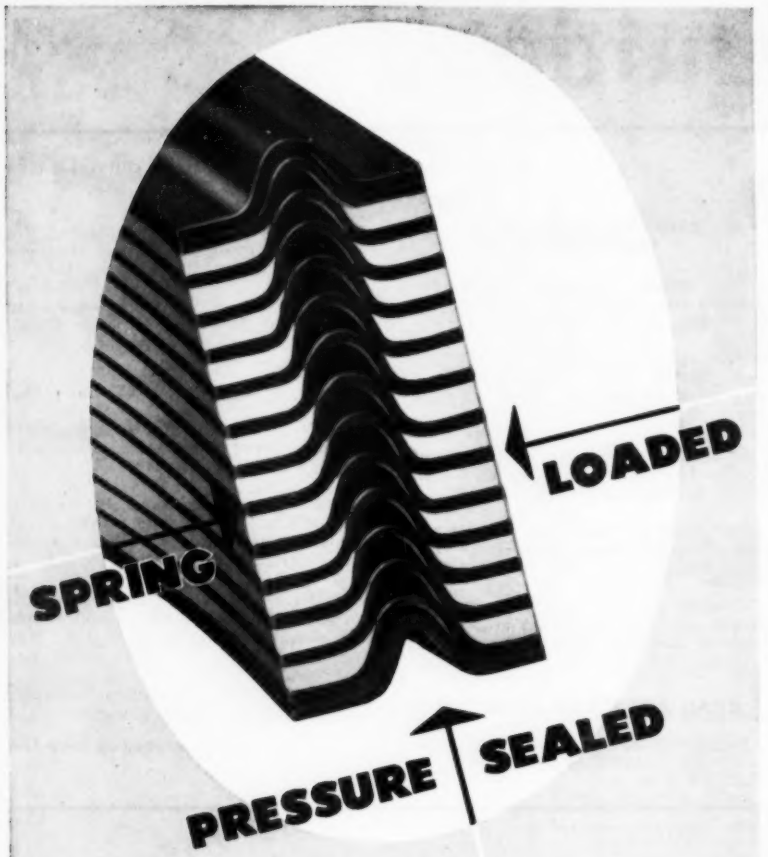
Bull L-667B1B contains complete information on Worthington YC-2

(Continued on page 150)

PRODUCT INDEX

Air & Dust Filters & Collectors ... 149
Anti-Corrosive & Protective Coatings ... 149
Boilers & Boiler Accessories ... 149
Building Materials & Maintenance ... 149
Coal, Ash & Bulk Handling ... 149
Compressors ... 149
Controls, Regulators & Instruments ... 150
Electrical Distribution ... 150
Fans & Blowers ... 150
Filters, Strainers & Purifiers ... 151
Fuels & Firing Equipment ... 151
Heat Exchanger Equipment ... 151
Lubricants, Lubrication, Oil Filters & Purifiers ... 151
Mechanical Power Transmission ... 152
Motors & Generators ... 152
Packaged Steam Generators ... 152
Packing & Gaskets ... 152
Pipe, Tubing & Hose ... 152
Pumps ... 153
Refractory Concretes ... 153
Soot Blowers & Tube Cleaners ... 153
Steam Specialties ... 153
Tools ... 154
Transformers ... 154
Turbines ... 154
Valves ... 154
Water Treatment ... 155

NOTE—This department is both a product index for advertising and a keyed listing for advertised literature. Refer to advertisement on page indicated and contact advertiser directly—or list paragraph key numbers on reader service card (page 147) to get data you want



It's the live-spring action and U-shape of the metal plies in Ajax Spiralwound Gaskets that permits them to give and take with varying pipe line or boiler stresses, to seal joints tight at safe bolt loads and utilize the pressures they are sealing against to keep them tight under all operating conditions.

There are types and sizes for all standard flanges and for manholes, handholes and tube caps for all makes of stationary and marine boilers, waterwalls, economizers, etc.

Materials of construction include plated low carbon steel or stainless, Canadian or blue African asbestos or chemically inert duPont Teflon.

Sold universally through industrial distributors. Ask your supply house or write—

UNITED STATES GASKET COMPANY

FABRICATORS OF "TEFLON" & "KEL-F" FOR THE CHEMICAL PROCESS & ELECTRONIC INDUSTRIES

CAMDEN 1 NEW JERSEY

Representatives in Principal Cities Throughout the World

readers' guide

to advertised products

(Continued from page 149)

compressors. Worthington Corp., Compressor Div. p 61. Key No. **517.**

Cat 51 10A gives information on the complete line of Schramm industrial compressors and accessories. Schramm, Inc. p 166. Key No. **518.**

CONTROLS, REGULATORS & INSTRUMENTS

Details available on Liquidometer tank gage. The Liquidometer Corp. p 176. Key No. **519.**

Bull 100 gives full details on wide line of automatic regulating valves. Spence Engineering Co., Inc. p 44. Key No. **520.**

Automatic control equipment for entire process plants, pipelines and pilot units is described on page 39. Hammel-Dahl Co.

Bull 148BP contains information on Cambridge dissolved oxygen recorder and dissolved hydrogen recorder. Cambridge Instrument Co., Inc. p 180. Key No. **521.**

Catalog gives information on Auto-Lite temperature indicators & recorders. The Electric Auto-Lite Co. p 174. Key No. **522.**

Bull 5P contains information on Mercoid magnet operated mercury switches. p 179. Key No. **523.**

ELECTRICAL DISTRIBUTION

Adv. p 10, 11 contain data on low voltage switchgear along with auxiliary and trip devices. I-T-E Circuit Breaker Co.

Price list and catalog on "Economy Delay" Renewable fuses. Economy Fuse and Mfg. Co. p 36. Key No. **524.**

Coupon in adv. p 14, 15 offers complete facts on Fusetron dual-element fuses. Bussmann Mfg. Co. Key No. **525.**

Bull GEA-3592 contains data on G-E load-center system. General Electric Co. p 18, 19. Key No. **526.**

Bulls GEA-5915 and GEA-5916 give full information on G-E's new line of circuit breakers. General Electric Co. p 32, 33. Key No. **527.**

FANS & BLOWERS

Cat 400 describes Chelsea explosion-proof fans for hazardous locations. Chelsea Fan & Blower Co., Inc. p 179, Key No. **529.**

Bull A-650 contains data on multi-stage centrifugal blowers. Bulletins on

stationary and portable industrial vacuum cleaning equipment also offered. U. S. Hoffman Machinery Corp. p 133. Key No. **530.**

FILTERS, STRAINERS & PURIFIERS

Adv. p 34 offers bulletin on Micro-Klean filters. Cuno Engineering Corp. Key No. **531.**

FUELS & FIRING EQUIPMENT

Bulls OB-37 and OB-38 contain data on Enco fuel oil pumping and heating units with instruction on care and operation. The Engineer Co. p 164. Key No. **532.**

Coupon on p 26, 27 offers complete data on Coppus-Dennis Fanmix burners. Coppus Engineering Corp. Key No. **533.**

Bulletin contains information on Detroit RotoGrate stokers. Detroit Stoker Co. p 51. Key No. **534.**

See adv. p 45 for information on bituminous coal. Bituminous Coal Institute.

Adv. p 141 describes Bell & Zoller superwashed coals. Bell & Zoller Coal Co.

Cat 501 contains descriptive data on Stowe stokers. The Johnston & Jennings Co. p 29. Key No. **535.**

HEAT EXCHANGER EQUIPMENT

Engineering data available on instantaneous water heaters. Pick Mfg. Co. p 134. Key No. **536.**

Bull 120 gives complete information on Niagara Aero heat exchangers. Niagara Blower Co. p 154. Key No. **537.**

Adv. p 60 contains information on Worthington deaerators. Worthington Corp., Steam Power Div.

LUBRICANTS, LUBRICATION, OIL FILTERS & PURIFIERS

Informative bulletin and free, testing sample of Non-Fluid oil. New York & New Jersey Lubricant Co. p 175. Key No. **538.**

Adv. p 182 contains data on Texaco Regal oils. The Texas Co.

Adv. p 55 gives information on Stanoil industrial oil. Standard Oil Co.

Adv. p 131 contains data on Sinclair Rubilene oil. Sinclair Refining Co.

Complete data available on Micro-Fog lubrication for bearings, gear chambers & small air devices page 173. C. A. Norgren Co. Key No. **539.**

Adv. p 158 contains information on Albany lubricating products. Adam Cook's Sons, Inc.

Coupon offers booklet "Hydraulic Fundamentals and Industrial Hydraulic Oils." Sun Oil Co. p 117. Key No. **540.**

(Continued on page 152)

Best by Test and Performance

STIC•TITE

INSULATING CEMENT

Easier to Work and Finish

Mix Stic-Tite with water and you get a plastic cement that's easy to work and finish smooth over block or blanket insulation on all types of heating equipment, around pipes, fittings and difficult shapes.

Sticks Tight • Durable

Applied to any required thickness over any clean surface—hot or cold—Stic-Tite quickly drives to an air-tight, strong, resilient, tough covering that stays on. It does not lift off or shake loose, even under vibration, abrasion or impact in normal operation.

Covers Better

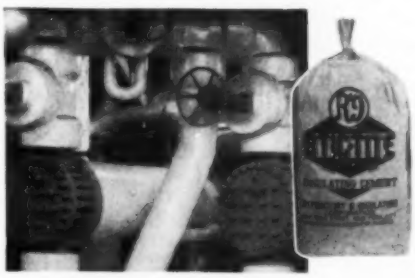
Stic-Tite is truly economical. It covers at least 45 sq. ft., one inch thick, per 100 lbs. of material.

Saves More Heat

Stic-Tite is the most efficient of plastic insulations. Its insulating value is indestructible under practically all service conditions up to 1800° F. Cover those flanges, fittings and other base surfaces with as little as 1½" thickness of Stic-Tite and you save at least 90% of the heat loss.

Easily Reclaimable

Stic-Tite need never be wasted or discarded, even if removed for equipment repairs. Easily crushed and remixed with fresh water, it can be reapplied as before.



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REFRACTORY & INSULATION CORP.

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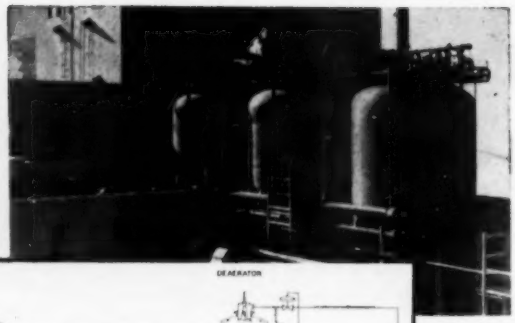
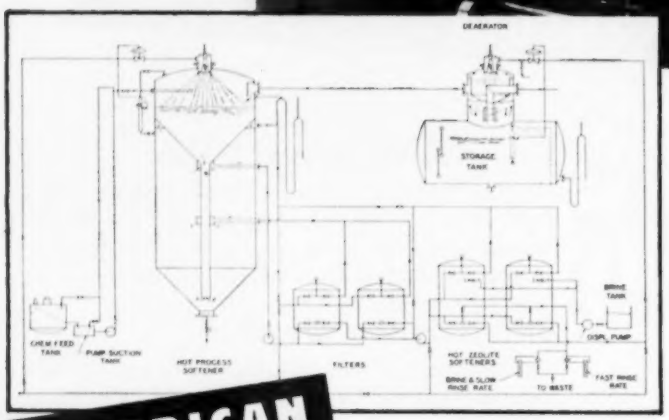
REFRACTORY BONDING AND CASTABLE CEMENTS

INSULATING BLOCK, BLANKETS AND CEMENTS

130 WALL STREET • NEW YORK 5, N. Y.

First three of seven American Softeners installed at a large mid-western refinery.





AMERICAN

Hot Process Softening

that assures positive, economical results

American Hot Process Softeners provide an economical efficient method of reducing hardness, alkalinity and other objectionable dissolved solids or gases from boiler feed water.

Operation of the American unit is simple. Water is sprayed through steam and heated to almost the saturation temperature at which point chemicals are added. The mixture then passes through a downcomer pipe to a suspended sludge bed through which it percolates and the clear effluent is drawn off at the top. Passing the water through the sludge bed also provides a filtering action and assures a more complete chemical reaction with resulting clearer, softer water than is possible in conventional settling tanks.

American Hot Process Softeners may either be used alone, as shown in the photograph above, or with a secondary Hot Zeolite Softener, shown in the schematic, in which the residual (non-carbonate) hardness is economically removed by ion exchange.

Fifty years of development in water conditioning have produced many firsts by American engineers . . . developments that assure you the ultimate in equipment design. Why not call or write today for the answer to your water problem.

SERVICE SINCE 1902 — TO THE INDUSTRY

AMERICAN *Water Softener* COMPANY
INCORPORATED

FOURTH AND LEHIGH AVENUE • PHILADELPHIA 33, PENNSYLVANIA

DEAERATORS • HOT PROCESS SOFTENERS • REACTORS • FILTERS • ZEOLITE SOFTENERS • CHLORIDE DEALKALIZERS • AERATORS & DECARBONATORS
HYDROGEN SODIUM ZEOLITE SOFTENERS • DEMINERALIZERS • CHEMICAL FEEDERS • CONTINUOUS BLOWDOWN • SWIMMING POOL EQUIPMENT

readers' guide

to advertised products

(Continued from page 151)

MECHANICAL POWER TRANSMISSION

Coupon on p 4 offers set of reports on users' experience and showing actual installations of grommet belts. The B. F. Goodrich Co. Key No. **541.**

Descriptive literature available on Lovejoy Universal Joints. Lovejoy Flexible Coupling Co. p 160. Key No. **542.**

MOTORS & GENERATORS

Descriptive bulletin contains information on U. S. Varidrive motors. U. S. Electrical Motors Inc. p 176. Key No. **543.**

PACKAGED STEAM GENERATORS

Cat 502 contains complete details on Superior packaged steam generators. Superior Combustion Industries, Inc. p 146. Key No. **544.**

Bull EC-52B shows the cost-cutting features of the Econotherm boiler. Hapman-Dutton Co., Dutton Boiler Div. p 54. Key No. **545.**

Coupon on p 156 offers bulletin on cutting steam costs with Amesteam generators. Ames Iron Works, Inc. Key No. **546.**

Complete facts available on Cleaver-Brooks combination gas and/or oil fired boilers. Cleaver-Brooks Co. p 59. Key No. **547.**

Catalog gives facts on Powermaster packaged boiler with Voriflow combustion. Orr & Sembower, Inc. p 137. Key No. **548.**

PACKINGS AND GASKETS

Illustrated catalog contains data on Crane Super Seal packing. Crane Packing Co. p 172. Key No. **549.**

Adv. p 150 contains data on Ajax spiral wound gaskets. United States Gasket Co.

Bulletins on Darcova pumcups: #4401 for reciprocating pumps; #4502 for air or hydraulic mechanisms. Darling Valve & Mfg. Co. p 169. Key No. **550.**

Adv. p 56 contains information on R/M Teflon packings and gaskets. Packing Div., Raybestos-Manhattan, Inc.

PIPE, TUBING & HOSE

Cat F-9 contains complete data on Vogt drop forged steel fittings. Henry Vogt Machine Co., Inc. p 42. Key No. **551.**

Available bulletin "Wrought Iron For Piping Systems" contains data on this product. A. M. Byers Co. p 37. Key No. **552.**

Cat 500 contains data on seamless & interlocking hose in bronze, steel & stainless steel. Atlantic Metal Hose Co. p 178. Key No. **553.**

Catalog gives information on RicwiL's Uniline insulated piping. The Ric-wiL Co. p 133. Key No. **554.**

PUMPS

Adv. p 127 contains information on Worthington vertical turbine pumps. Worthington Corp., Vertical Turbine Pump Div.

Adv. p 50 contains information on De Laval barrel type boiler feed pumps. De Laval Steam Turbine Co.

Information available on Milton Roy controlled volume pumps for boiler water treatment. Milton Roy Co. p 21.

Centrifugal pumps are described in adv. p 118, 119. Worthington Corp., Centrifugal Pump Div.

REFRACTORY CONCRETES

Free booklet on many uses of Lumnite for industrial concretes. Lumnite Div., Universal Atlas Cement Co. p 48. Key No. **555.**

Adv. p 151 offers free sample bag of Stic-Tite insulating cement. Refractory & Insulation Corp. Key No. **555.**

Bull R-22 contains data on B&W Kaocast. The Babcock & Wilcox Co., Refractories Div. p 120. Key No. **556.**

SOOT BLOWERS & TUBE CLEANERS

Adv. p 49 contains data on Diamond automatic Air Puff soot blower system. Diamond Power Specialty Corp.

Adv. p 168 offers information on Airetool tube expansion control system. Airetool Mfg. Co.

STEAM SPECIALTIES

Cat 751 (or see Sweet's) contains data on Nicholson expansion steam traps. W. H. Nicholson & Co. p 161. Key No. **557.**

Complete data available on the O. B. T. steam trap for draining gravity convectors. The Coe Mfg. Co. p 155. Key No. **558.**

Adv. p 67 offers new color film on steam trapping "Please Pass The Condensate." Yarnall-Waring Co. Key No. **559.**

Adv. p 181 contains information on Sarco steam traps. Sarco, Inc.

44-page steam trap book contains complete data on Armstrong trap design and operation. Armstrong Machine Works. p 2. Key No. **560.**

(Continued on page 154)

A COMPACT Turbine Blower Installation

Here is an example of the adaptability of the Wing Turbine Blower to the limitations of restricted space. Additional boiler installations at the E. R. Squibb & Sons, New Brunswick, N. J., plant left little space for auxiliary equipment. As the photograph shows, the complete Wing turbine and blower (47,000 CFM, at 5" s.p., at 1850 RPM) were placed beneath the rear boiler overhang and occupy a space but 54" in dia. by 33" high! (Another Wing unit occupies a similar space 45"x30".)

Compact design is but one of the many superiorities of the Wing Turbine Blower. In addition, they are quiet, rugged in construction, economical in operation and in maintenance. Wing Turbine Blowers cost nothing as a source of power when the oil free exhaust steam is used for process work, space heating or other uses requiring low pressure steam.

WING MOTOR DRIVEN Axial Flow BLOWERS are used on many of the country's leading makes of boilers as standard equipment. The reason lies in the consistently satisfactory performance they have been delivering for over half-a-century—plus the outstanding features of WING design, such as volume control (Voltrol Vanes) for capacity regulation down to 90%, ease of installation, quiet operation, compact construction, low maintenance cost. Wing Motor Driven Blowers give day-in-day-out, year-in-year-out satisfaction.

Type R Wing Turbine Blower

Write for a copy of Wing Bulletin SW-52

Wing

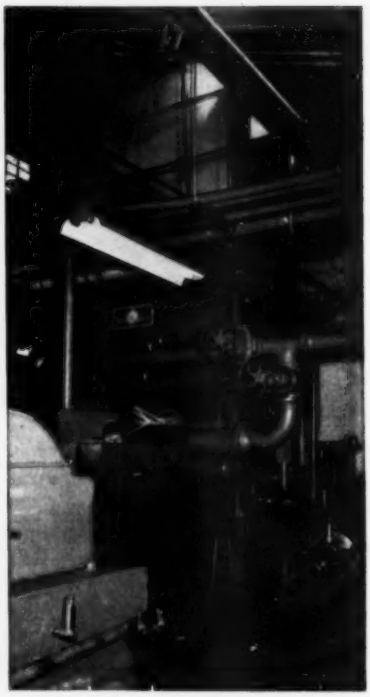
L. J. Wing Mfg. Co.
139 Vreeland Mills Road
Linden, New Jersey
Factories:
Linden, N.J. and Montreal, Canada

You Get Trustworthy Liquid or Gas Cooling With Great Cooling Water Savings from the NIAGARA AERO HEAT EXCHANGER

● You can cool air, gas, water, oils, chemicals, electric and power and process equipment, engines, mechanical processes with lower cost and really accurate control of temperature with the Niagara Aero Heat Exchanger.

You are assured of uniform, constant production and quality from any process . . . steady, reliable operation . . . lower cost for more dependable cooling. You can have closed system cooling with freedom from scale, dirt, corrosion and maintenance troubles. You can accurately cool more than one type of liquid with one machine.

The Niagara Aero Heat Exchanger uses atmospheric air to cool liquids and gases by evaporative cooling. You can remove heat at the rate of input to keep accurate control of gas or liquid temperature. You can put heat back into the system to save the losses of a "warm-up" period or to equalize the effect of load variations.



Great savings in cooling water and savings in piping, pumping and power return the cost to you quickly. The Niagara Aero Heat Exchanger can save you approximately 95% of your cooling water cost. Write for Bulletin 120.

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readers' guide

to advertised products

(Continued from page 153)

TOOLS

Adv. p 174 contains data on Skinner valve and bibb reseater. M. B. Skinner Co.

Interchangeable puller tools are described in the industrial and general catalog of 4,000 tools. Snap-On Tools Corp. p 167. Key No. **561.**

Catalog contains complete data on Toledo pipe tools and power pipe threading machines. The Toledo Pipe Threading Machine Co. p 165. Key No. **562.**

Illustrated literature and price list available on RCD drill bit for use with rotary electric or air drill. Rotary Concrete Drill Co. p 161. Key No. **563.**

Send 10c for 68-page catalog of Proto tools. Plomb Tool Co. p 6. Key No. **564.**

TRANSFORMERS

Catalogs contain data on the application of dry-type transformers. Acme Electric Corp. p 176. Key No. **565.**

TURBINES

Adv. pages 22, 23 contain information on several types of Elliott turbine-generators. Elliott Co., Steam Turbine Dept.

VALVES

Bulletin gives complete data on tests with revolutionary new superheater loop equipment. Edward Valves, Inc. p 30, 31. Key No. **566.**

Adv. p 57 gives information on Grinnell-Saunders diaphragm valves. Grinnell Co.

Cat No. 10 describes Chapman List 960 forged steel gate valves. The Chapman Valve Mfg. Co. p 138. Key No. **567.**

Adv. p 7 describes Crane packless diaphragm valves now available in new materials. Crane Co.

Catalog gives 4 ways to cut pump repairs. Sims Pump Valve Co., Inc. p 180. Key No. **568.**

Bull 277-2 gives details on Stabilflo control valves. The Foxboro Co. p 43. Key No. **569.**

Coupon on p 9 offers catalog with complete data on Jenkins cast steel valves. Jenkins Bros. Key No. **570.**

Bull 1-A gives information on stellited Atlas Type B steam reducing valves. Atlas Valve Co. p 132. Key No. **571.**

Valve catalog contains data on Rockwell butterfly valves. W. S. Rockwell Co. p 175. Key No. **583.**

Adv. p 128 contains information on Powers V-port flowrite valves. The Powers Regulator Co.

Information on Powers No-Pak pneumatic control valves is described on p 129. The Powers Regulator Co.

Catalog V-52 gives details on Saunders patent diaphragm valves. Hills-McCanna Co. p 144. Key No. **572.**

Bull 513 describes Leslie double seated diaphragm control valves. Leslie Co. p 123. Key No. **573.**

Cat FL 382 E describes the Farris Flex valve for controlling flow of hard-to-handle fluids. Farris Flexible Valve Corp. p 125. Key No. **574.**

WATER TREATMENT

Technical Bull 124 describes Betz filming amine treatment. W. H. & L. D. Betz. p 17. Key No. **575.**

Bulletins contain data on automatic control of processes for removal of water impurities. Belco Industrial Equipment Div., Inc. p 139. Key No. **576.**

HOW TO REQUEST FREE LITERATURE

Insert "key" numbers on return post card found on page 147. For quick reference to free literature offered by advertisers in this issue, refer to listing on page 156. Our Reader's Service Department will handle your request promptly.

Bull 1105 describes chemical feed pump for boiler water treatment. %Proportioneers, Inc.% p 35. Key No. **577.**

Adv. p 58 contains information on Worthington water softening system. Worthington Corp., Water Treating Div.

Bull V-11 contains data on H&T water softeners or demineralizers. Hungerford & Terry, Inc. p 176. Key No. **578.**

Reprint of informative article contains features and benefits of hot zeolite softening. Graver Water Conditioning Co. p 40. Key No. **579.**

Coupon on p 126 will bring complete details on the Chlorinizer slime control system. Builders-Providence, Inc. Key No. **580.**

Bull CP 100 contains all facts on amine treatment. The Bird-Archer Co. p 143. Key No. **581.**

Adv. p 152 contains information on American hot process softeners. American Water Softener Co.

Adv. p 13 offers details on water treatment security and new reprint of ASME Paper No. 52-A-30. National Aluminate Corp. Key No. **582.**

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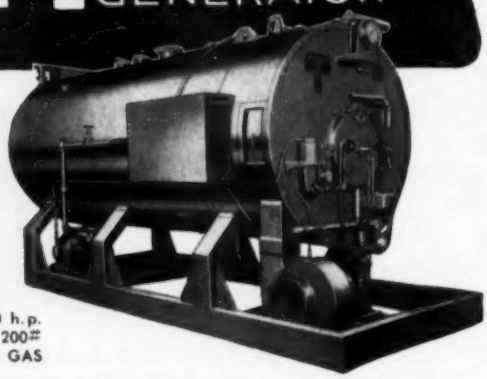

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176	Acme Electric Corp.	Transformers	565
156	Ames Iron Works Inc.	Amesteam generators	546
2	Armstrong Machine Works	Steam trap book	560
178	Atlantic Metal Hose Co.	Flexible metal hose	553
132	Atlas Valve Co.	Steam reducing valves	571
123	Babcock & Wilcox Co., Refractories Div.	Refractory concrete	556
139	Belco Industrial Equipment Div. Inc.	Automatic control	576
17	Betz, W. H. & L. D.	Return line corrosion	575
140	Bigelow Company, The	Type K boilers	504
143	Bird-Archer Co., The	Amine treatment	581
180	Blaw-Knox Div. of Blaw-Knox Co.	Steel grating	511
126	Builders-Providence, Inc.	Chloronizer slime control system	580
14	Bussmann Mfg. Co.	Dual-element fuses	525
37	Byers Co., A. M.	"Wrought Iron For Piping Systems"	552
180	Cambridge Instrument Co., Inc.	Gas analyzer	521
138	Chapman Valve Mfg. Co., The	Forged steel gate valves	567
179	Chelsea Fan & Blower Co., The	Explosion-proof fans	529
46	Chicago Pneumatic Tool Co.	Oil-less cylinder compressors	516
155	Coe Mfg. Co., The	Steam traps	558
38	Cooper-Bessemer Corp., The	Type M compressors	515
26	Coppus Engineering Corp.	Coppus-Dennis Fanmix burners	533
172	Crane Packing Co.	Super seal packing	549
31	Cuno Engineering Corp.	Micro-Klean filters	531
169	Darling Valve & Mfg. Co.	Darcova pumcups	550
51	Detroit Stoker Co.	RotoGrate stokers	534
130	Dings Magnetic Separator Co.	Magnets	513
36	Economy Fuse & Mfg. Co.	"Economy De-Lay" renewable fuses	524
30	Edward Valves, Inc.	Pressure seal valves	566
174	Electric Auto-Lite Co., The	Temperature indicators & recorders	522
161	Engineer Co., The	Fuel oil units	532
125	Farris Flexible Valve Corp.	Flex valves	574
178	Felt Products Mfg. Co.	Thread compound	509
179	Flexrock Co.	Floor patch	512
43	Foxboro Co., The	Stabilflo control valves	569
18	General Electric Co.	Load center system	526
32	General Electric Co.	Circuit breakers	527
4	Goodrich Co., The B. F.	Grommet V-belts	541
40	Graver Water Conditioning Co.	Hot zeolite softening	579
54	Hapman-Dutton Co., Dutton Boiler Div.	Econotherm packaged boilers	545
161	Henszey Co.	Continuous blowdown equipment	505
144	Hills-McCanna Co.	Diaphragm valves	572
176	Hungerford & Terry, Inc.	Water treatment	578
53	Ingersoll-Rand	Diesel-powered compressors	514
9	Jenkins Bros.	Cast steel valves	570
29	Johnston & Jennings Co., The	Stowe stokers	535
163	Kirk & Blum Mfg. Co., The	Fume control systems	501
145	Klemp Metal Grating Corp.	Diamond riveted grating	510
123	Leslie Co.	Diaphragm valves	573
176	Liquidometer Corp., The	Tank gage	519
163	Lovejoy Flexible Coupling Co.	Universal joints	542
179	Mercoid Corp.	Mercury switches	523
13	National Aluminate Corp.	Water treatment	582
175	New York & New Jersey Lubricant Co.	Non-fluid oil	538
154	Niagara Blower Co.	Heat exchangers	537
161	Nicholson & Co., W. H.	Expansion steam traps	557
173	Norgren Co., C. A.	Micro-Fog lubrication	539
137	Orr & Sembower, Inc.	Powermaster with Voriflow	548
134	Pick Mfg Co.	Instantaneous water heaters	536
151	Refractory & Insulation Corp.	Insulating cement	555
133	Ric-wil Co., The	Uniline insulated piping	554
175	Rockwell Co., W. S.	Butterfly valves	583
161	Rotary Concrete Drill Co.	Drill bit	564
135	Rust-Oleum Corp.	Stops rust	503
166	Schramm, Inc.	Industrial air compressors	518
180	Sims Pump Valve Co., Inc.	Pump valves	568
180	Smooth-On Mfg. Co.	Repair handbook	508
167	Snap-On Tools Corp.	Interchangeable puller tools	561
44	Spence Engineering Co., Inc.	Automatic regulating valves	520
117	Sun Oil Co.	"Hydraulic Fundamentals and Industrial Hydraulic Oils"	540
146	Superior Combustion Industries Inc.	Packaged steam generators	544
142	Thermix Corp., The	Dust collectors	502
165	Toledo Pipe Threading Machine Co., The	Pipe tools & power pipe threading machines	562
176	U. S. Electrical Motors Inc.	Varidrive motors	543
133	U. S. Hoffman Machinery Corp.	Centrifugal blowers	530
48	Universal Atlas Cement Co., Lumnite Div.	Industrial concrete	555
42	Vogt Machine Co. Inc., Henry	Steel fittings	551
157	Western Precipitation Corp.	Dust & Fly ash recovery	500
153	Wing Mfg. Co., L. J.	Turbine blowers	507
61	Worthington Corp., Compressor Div.	Compressors	517
67	Yarnall-Waring Co.	Film "Please Pass The Condensate"	559
62	Yarnall-Waring Co.	Liquid level indicators	506

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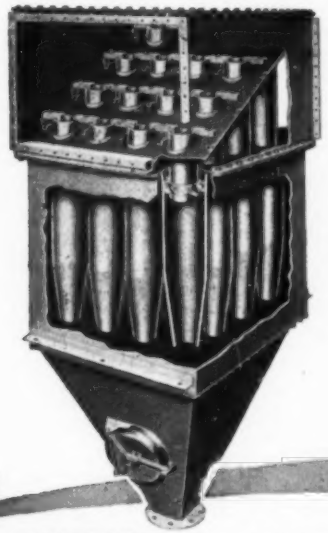
Before you buy *any* equipment for recovering dust or fly ash . . .



COMPARE ALL OTHERS against MULTICLONE'S Multiple Advantages

Because the advantages of MULTICLONE are so clear-cut, so vitally important, so far-reaching in the savings they make, we urge you to make a factual unbiased comparison of MULTICLONE dust and fly ash collection equipment against *any other* in the mechanical recovery field. Only by making such a comparison can you fully appreciate the major savings and greater performance you get by installing MULTICLONE Collectors!

COMPARE Recovery Efficiency!

It is a recognized fact that the separating efficiency of a cyclonic tube increases as the tube diameter decreases because smaller tubes generate greater centrifugal forces. The patented vane in the MULTICLONE makes the use of small tubes *practical* without complicated manifolding and permits compacting many small tubes into one simple, highly efficient unit. MULTICLONE's higher centrifugal forces throw out not only the large, medium and small particles, but also an unusually high percentage of the *extremely small* particles of 10 microns and less. Result—*more complete recovery of all suspended particles from the gas stream!*

COMPARE Space-Saving Compactness!

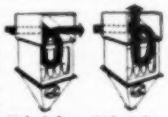
Plant space costs money—particularly at today's high construction costs. Because the MULTICLONE is more compact, size for size, it makes *really important* savings in space and plant costs. Note in the chart how the MULTICLONE requires substantially less space—*both in floor space and cubic space*—than any other unit of comparable capacity and performance. *This means vital savings in construction costs!*

Make	Relative Space Requirements In Sq. Ft.	In Cu. Ft.
Multiclone	1.0	1.0
Collector A	2.1	1.8
Collector B	5.9	3.2
Collector C	6.8	3.9

COMPARE Dollar-Saving Adaptability!

Savings in space is just one of many ways MULTICLONE reduces installation costs. Because the shape of the unit can be readily varied (long and narrow, short and wide, or square) to fit available spaces, the MULTICLONE can often be tucked into odd corners and waste areas too restricted for other equipment.

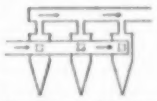
Moreover, inlet-outlet ducts can be varied—side-inlet side-outlet, or side-inlet top-outlet—to meet low headroom or restricted side clearance requirements . . . and the single-inlet single-outlet duct design permits greater flexibility and simpler installation. *These all add up to vital savings in installation costs!*



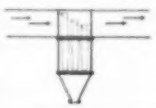
Side inlet, Side outlet ***Side inlet, Top outlet***

COMPARE All-Around Simplicity!

The MULTICLONE is simple and inexpensive to maintain because there are no highspeed moving parts to repair or replace . . . no pads or filters to clean or renew . . . nothing to choke the gas flow or increase draft losses as suspended materials are recovered. In addition, the square, flat-sided shape of the MULTICLONE and its straight inlet and outlet ducts are far simpler to install and insulate. And since the recovered material from an entire bank of tubes is collected in a *single* hopper, it is much easier to service and maintain than the multiple hoppers of conventional cyclone units. *Here again, the* MULTICLONE *saves in many ways—all of them important!*



Conventional Cyclone



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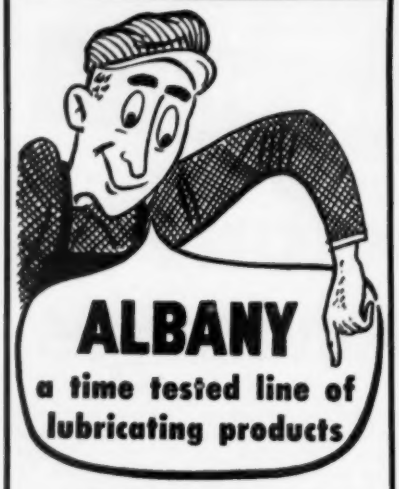

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Preventive Maintenance

"Practical Preventive Maintenance for Gas-Diesel and Diesel Engines," by H. T. Watson. Issued by the Cooper-Bessemer Corp., Mt. Vernon, Ohio. Illustrated. Price $2.00.

These manuals contain highly practical maintenance programs to insure continuous and efficient operation of gas and diesel engines. Field experiences are the keynote to this program, which shows a superiority to conventional maintenance methods for such equipment.

The program is detailed in two manuals. One covers gas-diesel and diesel engines, the second covers gas engines. In contrast to the usual periodic 8000-hr overall check or the progressive-type maintenance schedule, the manuals show how to perform continuing checks on engines while in service to accurately forecast internal conditions of the engines and anticipate operational needs.

Engine Indicator

"The Engine Indicator for Performance Evaluation," by J. D. Hines. Issued by the Cooper-Bessemer Corp., Mt. Vernon, Ohio. 54 pages, illustrated. Price $1.50.

This comprehensive booklet will assist operators of gas and diesel engines in keeping equipment at top operating efficiency. It reviews the various types of engine indicators and points out their limitations. Emphasis is placed on the use of the proper indicator and its correct application in improving performance of reciprocating engines and compressors.

How to analyze indicator cards is shown. Suggestions are given on how these data can be used for balancing engine cylinders and calculating mean indicated pressure. Also presented are suggestions for using the indicator to aid in engine design, in checking reciprocating compressors, determining compressor indicated horsepower, mechanical efficiency, and volumetric efficiency. Procedures for avoiding mechanical inaccuracy in the setup of indicators are included.

Fluid Flow

"Fluid Flow in Pipes," by Clifford H. McClain. Published by The Industrial Press, 148 Lafayette St., New York 13, N. Y. 128 pages, 18 illustrations and 9 tables. Price $3.00.

Properties of fluids affecting flow are discussed with illustrations of the overall influence of each. Theory, measurement, and dimensions of viscosity, with particular attention to relationships between various methods of measurement, are carefully explained for the beginner. Derivation calculations are included for those who wish to explore the subject more deeply. Friction and energy balance problems involving turbulance and streamline flow are solved with emphasis upon consistency in the evaluation of such factors as the Reynolds number.

Applications of the principles in the book to problems in piping and duct work are presented with calculations. Engineers and others who encounter only an occasional problem having to do with fluid flow, and whose knowledge of the subject may have become a little hazy, will find particular value in the straight-forward tracing of consistent dimensional units through the calculations involved. The book fills a need for a treatment of the theory and practice of fluid flow in pipes from a dimensional viewpoint.

Conveyer Nomenclature

"Conveyor Terms and Definitions," published by the Conveyor Equipment Manufacturers Association, One Thomas Circle, Washington 4, D.C. 64 pages, illustrated. Price $1.00.

This manual on standard nomenclature for conveyer types and parts contains about 1500 listings and line drawings. The glossary is designed to save time and money and avoid confusion for both users and manufacturers of conveying equipment.

Throughout the 64-page manual an attempt was made to define each type of conveyer by what it is rather than by what it does. The terminology has been adopted by members of the association and is the official standard for the industry. In addition to the glossary of terms, the manual contains a brief account of the conveyer industry in the American system of mass production, as well as a membership list and a brief history of the Conveyor Equipment Manufacturers Association.

Air Pollution

Chapter 6 of the Air Pollution Abatement Manual, "Sampling Procedures and Measuring Equipment," issued by the Manufacturing Chemists' Association. Prepared by Dr. Paul L. Magill of the Stanford Research Institute, Manufacturing Chemists' Association, Inc., Woodward Building, 15th and H Streets, Washington 5, D.C. 40 pages, illustrated. Price 75 cents.

Chapter 6 of the Air Pollution Abatement Manual sets forth the principles and methods to be followed in the collection of samples used for the study of air pollution problems. It describes various types of sampling equipment.

Collection of samples provides a means for determining types and properties of impurities, degree of contamination, and presence of toxic substances. The necessity for procuring the correct sample for a particular problem is emphasized, as well as the importance of statistical techniques in obtaining maximum precision.

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March 24-27, **National Power Show,** sponsored by National Association of Power Engineers, Hotel Sherman, Chicago.

APRIL

April 10-11, **Michigan Engineering Society,** annual meeting, Kellogg Center Hotel, Michigan State College campus, East Lansing, Mich.

April 14-16, **Conveyor Institute,** conducted by the University of Illinois Dept. of Mechanical Engineering in cooperation with the Conveyor Equipment Manufacturers Association, Illini Union Building on the U. of I. campus, Champaign, Ill.

April 22-24, **American Institute of Electrical Engineers,** Southern District meeting, Hotel Seelbach, Louisville, Ky.

April 28-30, **The American Society of Mechanical Engineers,** spring meeting, Deshler-Wallick Hotel, Columbus, Ohio.

April 29-May 1, **American Institute of Electrical Engineers,** North Eastern District meeting, Sheraton Plaza Hotel, Boston.

MAY

May 4-6, **Compressed Air & Gas Institute,** King & Prince Hotel, St. Simons Island, Ga.

May 10-15, **American Water Works Association, Inc.,** annual national convention, Grand Rapids, Mich.

May 11-13, **Heat Exchange Institute,** The Greenbriar, White Sulphur Springs, W. Va.

May 25-27, **Hydraulic Institute,** Seaview Country Club, Absecon, N. J.

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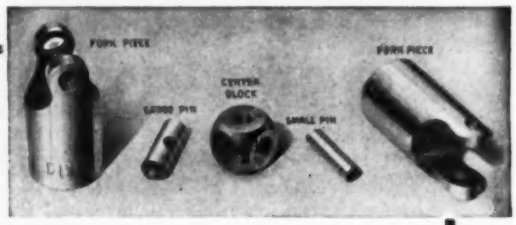

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Again demonstrating their remarkable effectiveness as a low-cost temperature control, a large processor reports Nicholson expansion steam traps, at about $35 each, are being installed on outdoor tanks and stills in place of temperature controls. These were costing $110.00 to $200.00, with cost of trap added.

The Nicholson traps are readily adjusted to pass condensate at any temperature below 212°F. No air binding. Lengths, 9" to 40". Easily installed, usually without supports. Pressure, 0 to 250 lbs.

TYPE RF Expansion Steam Trap — Installed horizontally. Both types are for steam or hot water; pressure to 250 lbs.

TYPE SF — Installed horizontally or vertically without supports.

For All Equipment Using Steam or Hot Water

Absorption Stills	Heavy Oil Tanks	Separators
Cookers	Molding Presses	Steam Stills
Dry Kilns	Pipe Coils	Sterilizers
Evaporators	Preheat Tanks	Switch Heaters
Gas Holders	Railway Coaches	Tracer Lines
Heat Exchangers	Retorts	Wax Tanks

Catalog 751 or see Sweet's

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RCD Drill Bit for use with rotary electric or air drills

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(with simple chemical treatment)

This compact self-contained unit is completely assembled. Can be installed by your own men in hours. It provides completely automatic control of boiler water concentration regardless of variations in boiler load. This is accomplished WITHOUT HEAT LOSS. Maintain clean efficient boilers for substantial savings in fuel, equipment and manpower.

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Boiler Feed Regulators • Distillation Systems • Heat Exchangers • Feed Water Meters

Flow Indicators • Proportioning Valves

Also MILK EVAPORATORS and PREHEATERS

new bulletins

and catalogs from leading manufacturers

AIR & DUST FILTERS & COLLECTORS

200—Dust Control Equipment

Dust control equipment for foundries is the subject of revised 28-page brochure 1152. Latest information, installation photos and diagrams of multi-wash collectors, hoods, and cupola collectors are presented. Claude B. Schneible Co.

201—Electrode Rapping System

Discussed in 6-page folder M1 is the theory of operation for a recently developed magnetic impulse, continuous, intensity controlled rapping system for electrostatic precipitators. Major components and construction features are summarized. Research Corp.

CONTROLS, REGULATORS & INSTRUMENTS

202—Flow Meter

Subject of 12-page bulletin 380-G2A is a propeller-type totalizing flow meter with a direct-reading counter. How this unit can be used as a totalizer-indicator-recorder to transmit information to remote points is described. An alarm register also is presented for use on batch operations. A useful engineering information section is provided. Builders-Providence, Inc.

PRODUCT INDEX

Air & Dust Filters & Collectors 162
Anti-Corrosive & Protective Coatings 164
Boilers & Boiler Accessories 162
Building Materials & Maintenance 164
Coal, Ash & Bulk Handling 166
Controls, Regulators & Instruments 162
Diesels 165
Electrical Distribution 165
Electrical Heating Units 167
Electrical Insulation 168
Engines 168
Fans & Blowers 168
Filters, Strainers & Purifiers 169
Heating, Air Conditioning, & Refrigeration 168
Heat Exchanger Equipment 169
Hydraulic Equipment 169
Instruments for Measure of Electricity .169
Mechanical Power Transmission 166
Motors & Generators 172
Packaged Steam Generators 172
Pipe, Tubing & Fittings 169
Pumps 172
Soot Blowers & Tube Cleaners 172
Thermal Insulation 172
Transformers 174
Valves 173
Water Treatment 174
Welding Equipment 175
Miscellaneous 175

203—pH Control

Discussed in 24-page brochure 1550 is the theory of measurement and control of pH, oxidation-reduction potential, and conductivity. Details of the basic systems are outlined, and auxiliary equipment is described. A quick reference table outlines various industrial processes and the benefits gained by the use of controlling and measuring equipment. Industrial Div., Minneapolis-Honeywell Regulator Co.

204—Industrial Controls

Applications, construction, and advantages of numerous types of industrial controls are outlined in 32-page catalog F-3941-2. Included are many types of temperature and humidity controls, motor-operated valves, and control motors. One page also discusses control terminology. Barber-Colman Co.

205—Liquid Level Gages

Liquid level gages for application on tanks, boilers, stills, or any liquid containing vessel, are the subject of 4-page folder 184. Construction, advantages, and specifications are presented. Also described are reflex gages for special applications. Jerguson Gage & Valve Co.

206—Graphic Panels

To show how graphic panels are used in various industrial applications, photos of actual installations are contained in 4-page folder PI-153. Component parts also are shown. Users in the petroleum industry, chemical and process industries, and power plants are listed. Panellit, Inc.

207—Tachometers

Single range, strip chart, panel mounting speed recorders are described in technical data sheet 81M. Typical applications, important features, selection of proper unit, and installation information are presented. Metron Instrument Co.

208—Recording Controller

How to select the appropriate controller action to match requirements of a process is explained in 16-page bulletin 465. A simple recorder instrument for automatically controlling process variables such as temperature, pressure, liquid level, and humidity is described. Construction of the unit and component parts of pneumatic control systems are discussed. Also described are indicating controllers, electric controllers, chart records, instrument specifications, and mounting dimensions. The Foxboro Co.

209—Recording Charts

Described in a 12-page bulletin is a service for supplying roll and dial charts to industry. According to the literature, charts for many different instruments may be purchased through this one source. Manufacture of the charts is discussed. Technical Charts Inc.

210—Level Control

Outstanding features of an electronic level control are summarized in 8-page brochure F-101. Applications, specifications and installation are described. Standard electrodes and cables also are discussed. Fielden Instrument Div., Robertshaw-Fulton Controls Co.

211—Transducers

According to 12-page bulletin 15-16, consumption of electric power in certain process operations is the only measurable or isolable variable. The application of power measurement transducers to such processes is described, and technical data on a few examples are given. Applications of thermal converters, solenoid-plunger ammeter, torquemeter, vacuum thermocouple, rectifying current system, precision shunt, saturable reactor and magnetic amplifier are covered. Diagrams, tables of characteristics and mathematical formulas are supplied. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

212—Venturi Nozzle

Discussed in bulletin 130-J6 is a plastic lined venturi nozzle designed for corrosive liquids. The literature describes it as a flanged type differential producer without piezometer rings. Corrosive liquids that can be metered are listed, and a ratio chart and capacity table for obtaining capacities of liquids other than water are presented. Builders-Providence Inc.

213—Control Panels

Engineering and planning of combustion and process control panels is discussed in 8-page bulletin 170. Numerous panel designs are discussed, along with the most up-to-date methods of tubing and wiring. A section on panel accessories serves to make a valuable source book of ideas for control station planners. Bailey Meter Co.

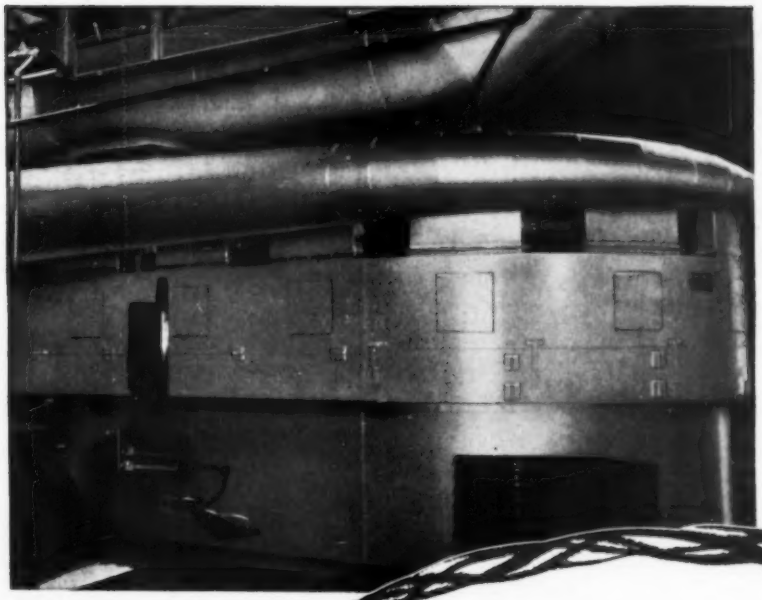
BOILERS & BOILER ACCESSORIES

214—Boiler Control

How a system of boiler control and instrumentation operates is shown in three diagrams contained in 10-page bulletin 1007. Descriptions are given for each component part, including combustion, feed water, boiler steam temperature, and soot blower controls. Instrumentation includes standard and miniature units with conventional, console, or graphic panels. Copes-Vulcan Div., Continental Foundry & Machine Co.

(Continued on page 164)

NOTE — Each new bulletin item has a key number for your convenience in asking for a free, personal copy. Insert key numbers on return post card found on page 147.



KIRK & BLUM Fume Control on an Automatic Plating Machine in a noted auto ignition parts plant. Note hinged anode access and inspection doors just above tank top.

KIRK AND BLUM FUME CONTROL SYSTEM

...Saves 5 Ways

1. REDUCES AIR VOLUME REQUIRED
2. LOWERS MAINTENANCE COSTS
3. CUTS REPLACEMENT COSTS
4. IMPROVES WORKING CONDITIONS
5. ELIMINATES DAMAGE TO OTHER EQUIPMENT

Considering the cost of plating equipment, can you afford to be without really efficient fume control? In both large and small plants, Fume Control Systems engineered, fabricated and installed by KIRK & BLUM have shown substantial savings by increasing the life of plating equipment.

A hood—with convenient access openings encircles the tanks—preventing cross currents and reducing air volume requirements.

Fumes are picked up at the outside of the tank, clean air is drawn over the machine's mechanism in the center, thereby keeping damaging corrosive fumes away from costly moving or mechanical parts.

Let a KIRK & BLUM Engineer survey your plating operations without obligation.

Write for Booklet F, showing typical installations. The Kirk & Blum Mfg. Co., 3174 Forrer Street, Cincinnati 9, Ohio.

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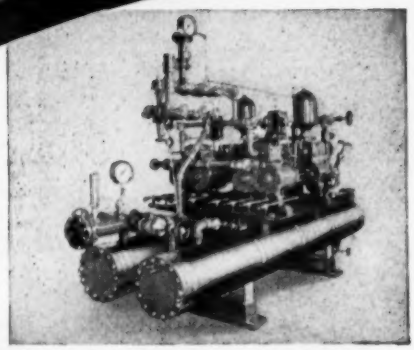
Enco Automatic
OIL PUMPING
AND HEATING SYSTEM

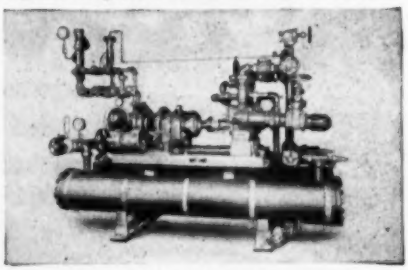
Completly Coordinated

Every detail part of an Enco Automatic Oil-Heating-and-Pumping Unit System is designed, assembled, checked and tested to make sure that it functions as an element of a completely coordinated unit. The sizes of pipes, fittings, valves and other elements are correctly proportioned for the efficient, dependable operation of the unit as a whole. All hand controls are visible and within reach of the operator for quick starting, stopping or cross-over reconnections between duplicate heaters and pumps. Adjustments and cleaning are similarly simplified.

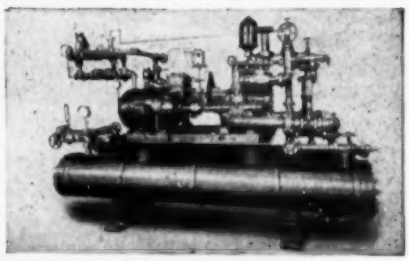
Single or duplicate heaters and electric or steam-driven pumps are used. Interconnected duplicate units give full capacity with either pump or either heater. Capacities range from 100 to 5000 G. P. H. of heavy bunker oil.



Two Horizontal Duplex Piston Type Steam Pumps and two fuel oil heaters—capacity 15 G. P. M. at 250 lb. pressure with either pump or heater.



One Turbine and One Motor Driven Pump and two fuel oil heaters. Capacity 30 G. P. M. at 150 lb. pressure with either pump or heater.



One Horizontal Duplex Piston Type Steam Pump and one Motor Driven Pump and two fuel oil heaters. Capacity 20 G. P. M. at 300 lb. pressure with either pump or heater.

BULLETINS ON REQUEST

OB-37 On oil burning, pumping and heating equipment.

OB-38 Instruction book on care and operation of oil-burner installations.

THE ENGINEER COMPANY
75 WEST STREET Enco NEW YORK 6, N.Y.

new bulletins

(Continued from page 162)

215—Jet-Tray Deaerators

Operation of jet-tray type deaerators is discussed in 4-page folder 400A. A cutaway view shows construction. Function, design, application and outstanding features also are discussed. American Water Softener Co., Inc.

216—Relief Valves

Specifications and brief descriptions of pressure, temperature, and combination pressure and temperature relief valves are contained in 8-page catalog C-49. Also presented are boiler water feeders, feeder cut-off combinations, low water fuel cut-offs, and pump controls. McDonnell & Miller, Inc.

217—Steam Gage Illuminators

Mercury vapor illuminators for steam gages are the subject of data sheet 196. Unmistakable water level indication is provided by a brilliant green spot at the water level. How it is installed on standard gages is discussed. Jerguson Gage & Valve Co.

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218—Boiler Water Feeders

Condensed information on boiler water feeders, pressure and temperature relief valves, low water fuel cut-offs and pump controls is given in 8-page catalog C-49. Service recommendations are included. McDonnell & Miller, Inc.

ANTI-CORROSIVE & PROTECTIVE COATINGS

219—Rust Preventive Coatings

Complete instructions for surface preparation and application of rust preventive coatings are given in 16-page general catalog. Many important facts also are brought out in a question and answer section. Color chips are given for primers, short oil types, long oil types, machinery and implement finishes, chemical and heat resistant types, sealers, thinning oils, and floor and masonry coatings. Rust-Oleum Corp.

BUILDING MATERIALS & MAINTENANCE

220—Vacuum Cleaning System

Operation of a central vacuum cleaning system, for industrial and institutional applications, is discussed in 20-page booklet D-5. Component parts, including exhauster unit, separators, piping system, and attachments, are presented. Basic engineering information is included to make it possible for the reader to plan a system in complete detail. Billmyre Blower Div., Lamson Corp.

221—Safety Treads

Quick-reference information on the design, application, and repair of safety treads is contained in a 36-page pocket size booklet. Engineering drawings show construction and application for many types

of treads, including grooved and abrasive-cast types. Expansion plates, platforms, curb bars, and floor grids also are described. Wooster Products, Inc.

222—Jet Cleaners

Steam and hot water jet-type cleaners are described in 6-page folder 70. Units are operated entirely by electricity. Advantages, applications, and data are presented. Livingstone Engineering Co.

DIESELS

223—Diesel Engines

To show the simplicity of diesel engine construction and to provide an understanding of the operation, "What You Should Know About Diesel Engines", 28-pages, is written in a non-technical style. Comparisons are made between diesels and gasoline engines, and between 2-cycle and 4-cycle diesels. Latest advancements also are discussed. P & H Diesel Div., Harnischfeger Corp.

ELECTRICAL DISTRIBUTION

224—Fuses

Renewable time-delay fuses, one-time fuses, plug fuses, fuse holders, and copper link fuses are listed in 28-page catalog 16-132. A technical data section covers such subjects as how a fuse operates, maintenance hints, excerpts from the 1951 National Electrical Code, and dimensions of fuses and fuse holders. Construction Materials Div., General Electric Co.

225—Circuit Breaker

Design and construction of a magnetic air circuit breaker arranged for installation in vertical lift switch gear rated 4.16 kv is described in 4-page folder 18B6346B. How the unit interrupts short circuit current is explained. Ratings and dimensions are listed in tables. Allis-Chalmers Manufacturing Co.

226—Bus Duct

How bus duct solves distribution problems arising from modernization, expansion, or new building programs, is explained in 12-page booklet B-5835. Four types of bus duct are described: plug-in duct, low-impedance duct, weatherproof feeder duct, and weatherproof low-impedance duct. The use of prefabricated elbows, tees, crossovers, and sliding-type cantilever hangers also is discussed. Westinghouse Electric Corp.

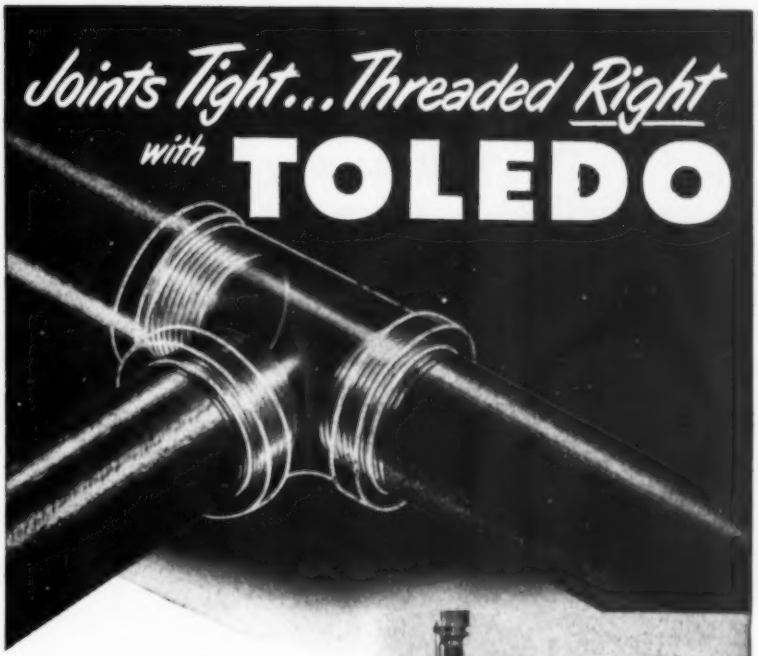
227—Control Centers

"Why a control center?" In answering this question, 32-page booklet B-6621 discusses characteristics that make for flexibility of application, ease of servicing, and safety of operating personnel. Three types of control centers together with various electrical components are described. Information is included to aid in selecting the right control center arrangement and starter size. Westinghouse Electric Corp.

228—Distribution Practices

"Industrial Power Distribution Idea Book," 28-page booklet GEA-5900, has been published as a guide on distribution practices in large and small plants. A few of the topics discussed are: what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; types of load-center distribution systems; use of branch feeder switches, starters and fuses; grounding of systems; how to calculate interrupting capacity; how to apply capacitors; and methods of obtaining economical d-c supply. General Electric Co

(Continued on page 166)



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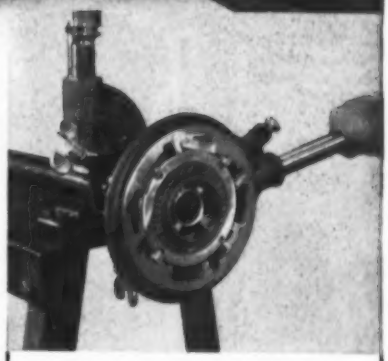
Any way you look at it—you'll do better with TOLEDO Pipe Tools and Power Pipe Machines on the job!

Better workmanship . . . good mechanics for fifty years have found they can always depend on TOLEDO to produce clean-cut threads for tight, leak-proof joints.

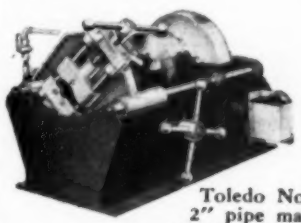
Faster production . . . whether it's hand tools or power pipe machines, Toledo gives you top-speed threading, cutting and reaming . . . ease of operation . . . accurate, efficient performance.

Lower costs . . . it all adds up to *big savings for you* in job-time and labor with Toledo dependability! Write for catalog on complete line. The Toledo Pipe Threading Machine Co., Toledo, Ohio. New York Office: 165 Broadway, Room 1310.



Toledo SIMPACT — self-contained, adjustable threader, 1"to 2" pipe.

Toledo Small Ratchet Threaders made in three models, ¼" to 2" pipe.



Toledo No. 999 2" pipe machine, wheel or knife cut-off.

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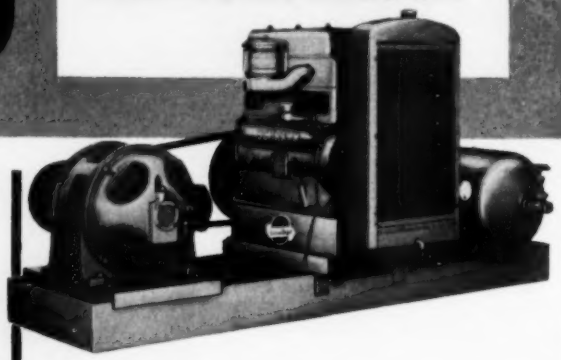
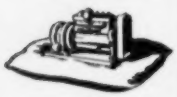
TOLEDO

PIPE TOOLS...POWER PIPE MACHINES...POWER DRIVES

8 reasons why you save $$$$ when you buy a SCHRAMM AIR COMPRESSOR



"V" Belt Drive With Motor, Cooling Unit And Horizontal Air Receiver



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COMPACT Occupies only a fraction of the space required by other makes and designs of compressors.

UNIT SYSTEM You can install several Schramm Compressors, as your needs require, in a minimum of space.

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LOW INITIAL COST Built in sizes ranging from ½ to 100 horsepower. Schramm ratings are given in actual air delivery at 100 p.s.i.g. and not piston displacement.

Write for a free copy of Schramm Catalog 51 10A for information on the complete line of Schramm industrial compressors and accessories.

SCHRAMM, INC.

The Compressor People

WEST CHESTER • PENNSYLVANIA

new bulletins

(Continued from page 165)

COAL, ASH & BULK HANDLING

229—Bucket Elevators

Many types of bucket elevators, designed to cover practically any need in elevating loose bulk material, are described in 78-page catalog 850. Applications for each type are discussed, and illustrations show actual installations. Details of construction and dimensions of the units and component parts are presented. The Jeffrey Manufacturing Co.

230—Conveyer System

How a recently installed interfloor-conveyer system cut receiving-to-storage time is discussed in a reprint. The article tells how the system eliminated a long truck haul, stopped elevator congestion, and reduced unloading time of highway trucks. Included are descriptions of the vertical interfloor conveyer, feeder conveyer, takeaway conveyer and automatic control system. Gifford-Wood Co.

231—Screw Conveyers

How screw conveyers and screw feeders are used to convey, elevate, heat, cool, and mix many different types of materials is discussed in 92-page booklet 2289. Detailed information, including selection tables, horsepower formulas, layouts, and specifications, aids in selecting equipment for many types of applications. One table lists 250 different materials, classifying them by size, flowability, abrasiveness, and average weight. In addition to helicoid flight and sectional flight conveyer screws, many other types designed for special conditions are discussed. Link-Belt Co.

MECHANICAL POWER TRANSMISSION

232—Helical Gear Drives

Advantages of helical gear drives are discussed in 16-page booklet 2451. Cross-sectional views show design and construction features of double and triple reduction types, and photos picture typical installations. Factors governing selection are described in detail. Tables list horsepower ratings, ratios and input speeds for units from fractional to over 100 hp and ratios to approximately 300:1. Load classes for 170 types of machines are listed alphabetically. Link-Belt Co.

233—V-Belts

Advantages of a high capacity V-belt are outlined in 4-page folder 20B7786. This type of V-belt is recommended for use in tight spots, for changed peak loads, for resisting oil, weather, and chemicals, for cutting sheave costs, and where static is a factor. Allis-Chalmers Manufacturing Co.

234—Gear Couplings

Advantages of flexible gear couplings are described in 16-page brochure C 4. The construction of many types, including standard, mill motor, vertical shaft, floating shaft, and spacer types is discussed. Typical installations and specifications also are presented. A useful engineering data section provides information on installation, lubrication, selection, bore tolerances, recommended keyways, and service factors. Sier-Bath Gear & Pump Co., Inc.

235—Speed Reducers

Heliocentric and helical gear speed reducers are briefly described in 8-page catalog section 1-A. Units are listed from 1/8 to 6000 hp with ratios from 3:1 to 1,000,000:1. A description of the heliocentric principal also is presented. Universal Gear Corp.

236—Power Transmission

Descriptions of power transmission equipment are featured in 36-page catalog R-103-A. Listed are such products as V-belts, detachable link V-belting, pulleys, sheaves, roller chain, belt lacing and speed reducers. Useful engineering data are outlined in charts and diagrams. Rockwood Pulley Manufacturing Co., Inc.

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237—V-Belts

Construction features of multiple and light duty V-belts are summarized in 8-page bulletin 3787. Tables list specifications and conversion tables explain identification systems of various manufacturers to aid in belt replacement. Thermoid Co.

238—Disc Brakes

Airplane-type disc brakes for industrial uses are the subject of 8-page bulletin A1725K. In addition to pointing out the advantages of employing single disc brakes, the booklet also describes a few of the varied industrial applications. Industrial Brake Dept., Aviation Products Div., Goodyear Tire & Rubber Co.

ELECTRICAL HEATING UNITS

239—Electric Heaters

Electric heaters and heating devices, described in terms of application, special features, and installation, are presented in 64-page catalog GEC-1005D. Indexed by process and application, the catalog also gives formulas and graphs for determining power requirements and heat losses. Among the equipment listed are immersion, strip, cartridge, tubular, insertion, and fin type heaters, as well as melting pots, thermostats, switches, oven heaters, and induction heaters. General Electric Co.

240—Far-Infrared Panels

Specifications of Chromalox electric far-infrared radiant panels are detailed in 4-page folder L-1093, for use by Federal, State, and local government purchasing agencies, and others required to purchase by invitation and bid. Items include every component part and characteristic of the panel. The modular panels are assembled into complete infrared ovens, and include full insulation and electric bus. Edwin L. Wiegand Co.

(Continued on page 168)

handle ALL pulling jobs swiftly . . . easily . . . with

Snap-on*

INTERCHANGEABLE PULLER TOOLS

NO NEED to invest in an extensive, costly assortment of puller tools! Snap-on pullers and parts are *engineered* for maximum interchangeability. They handle the widest range of operations with greatest speed and safety with fewest units, lowest cost. The Industrial Puller Set illustrated, CG-608, will handle all puller operations encountered in most shops—size capacity up to 14" diameter with power up to 20 tons.

Write for Snap-on Industrial Catalog and General Catalog of 4000 hand and bench tools. A nearby Snap-on factory warehouse is ready to give you immediate service on all your tool requirements.

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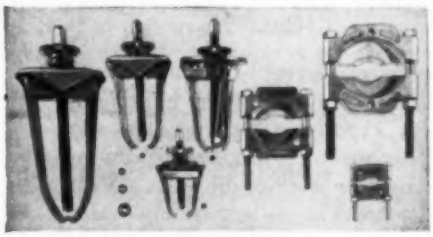
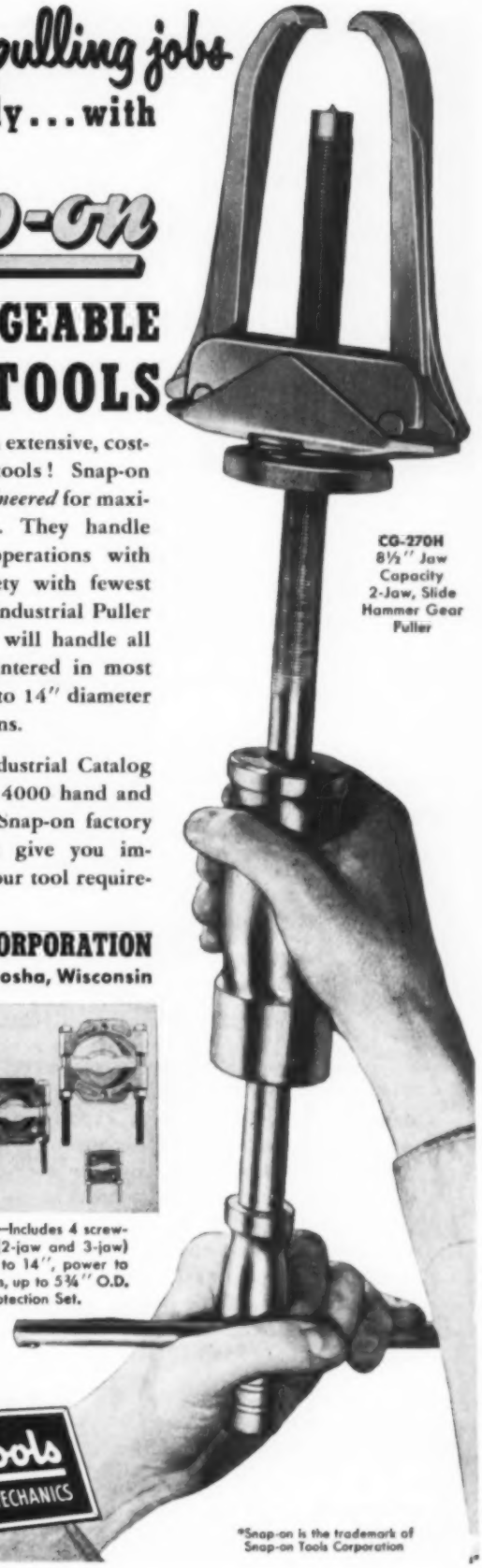


CG-608 Industrial Puller Set—Includes 4 screw-type pullers—small, medium (2-jaw and 3-jaw) and large. Size capacity up to 14", power to 20 tons. 3 Bearing Separators, up to 5¾" O.D. capacity, and Screw Point Protection Set.



CG-270H 8½" Jaw Capacity 2-Jaw, Slide Hammer Gear Puller

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THE CHOICE OF BETTER MECHANICS

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One of many reasons why skilled industrial maintenance men prefer the

AIRETOOL TUBE EXPANSION CONTROL SYSTEM

rolls tube joints tight automatically

Now science replaces "sensitive feel" in tube rolling! The AIRETOOL Tube Expansion Control System eliminates danger of over or under expansion. It automatically regulates the amount of expansion, produces maximum tightness and holding strength in every tube joint! With this system you can actually cut tube rolling time in half! Easy to use. Set dial for tube size, insert ball bearing expander and start powerful motor. When the tube joint reaches proper expansion and tightness, the control automatically shuts off the power. For more information and a convincing demonstration, write to:

There's an Airetool Tube Cleaner and Tube Expander for Every Type of Tubular Construction.

AIRETOOL
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BRANCH OFFICES: Philadelphia • New York • Chicago Tulsa • Baton Rouge • Houston • Hudson Heights (N.J.) REPRESENTATIVES in principal cities in U.S.A., Canada, Mexico, South America, England

new bulletins

(Continued from page 167)

ELECTRICAL INSULATION

241—Electrical Tapes

Specifications for electrical tapes and related electrical products for construction and maintenance are given in 12-page brochure E-CMBR (1221) LP. Descriptions are given for plastic tapes, glass cloth tape with thermosetting adhesive, and insulation putty in tape form. Electrical spring connectors and a coating also are discussed. Minnesota Mining & Mfg. Co.

ENGINES

242—Gas Engines

Spark-fired, 4-cycle gas engines are the subject of 4-page folder 221. Advantages and construction are described. A table lists 9 and 13 in. bore sizes ranging from 265 to 4260 hp in non-supercharged, supercharged, supercharged and intercooled, and Supairthermal types. Nordberg Mfg. Co.

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FANS & BLOWERS

243—Bifurcator Fans

Induced draft bifurcator fans are described in 8-page brochure DB-32-52. Line drawings are employed to suggest methods of installing. Construction details are discussed, and tables of specifications list 24 sizes for high pressure boilers to 60,000 lb per hr and low pressure units rated up to 190,000 EDR. DeBothezat Fans Div., American Machine and Metals, Inc.

HEATING, AIR CONDITIONING, & VENTILATION

244—Roof Ventilators

Various types of power roof ventilators are described in 16-page bulletin 3704. In addition to discussions of the applications and construction, engineering information such as performance data and dimensions are presented. To aid in selection, tables of steam heating capacities, fan capacities, steam conversion factors, and air friction of coils and filters are presented. American Blower Corp.

245—General Catalog

Equipment for buildings and institutions is the subject of 20-page bulletin WP-1099-B27M. Condensed information is provided on such equipment as air conditioning and refrigeration products; oil, gas, and dual fuel engines; deaerators and deaerating heaters; water conditioning; steam turbines and turbine generators; liquid meters; centrifugal pumps; regenerative turbine pumps; vertical turbine pump; and multi-V drives. Worthington Corp.

246—Unit Heater Steam Traps

How to figure condensing rates and select proper steam traps for draining unit heaters is the subject of 8-page bulletin 231. Output ratings for unit heaters from various manufacturers are tabulated, and constants are given for conditions other than specified. Armstrong Machine Works.

HEAT EXCHANGER EQUIPMENT

247—Water Heaters & Coolers

Drawings contained in an 8-page brochure show a wide variety of water heaters and coolers. Diagrams are used to explain how each individual unit functions. In addition to product descriptions, the literature contains useful tables dealing with heater selection, sizes and capacities. Manning & Lewis Engineering Co.

INSTRUMENTS FOR MEASURE OF ELECTRICITY

248—Voltammeter

For simultaneous potential and current measurements, data sheet 6AA describes an a-c voltammeter suitable for field use. Ranges listed for the instrument are 0.2 to 500 amp and 30 to 600 v. Associated Research Inc.

249—Electrical Instruments

Data sheet 10AA provides a source of quick reference to a line of electrical measuring instruments. Principle features of each unit are summarized. Models for insulation resistance, ground resistance, and high voltage testing plus other special purpose instruments, are represented. Associated Research, Inc.

FILTERS, STRAINERS & PURIFIERS

250—Line Type Purifiers

How mechanical separators reduce costs by removing such entrainment as dirt, solids and moisture from steam, vapor, compressed air, and gases is explained in 8-page bulletin 501. Diagrams show how small line type purifiers are installed. Suggested applications, advantages, specifications, and selection data are outlined. The V. D. Anderson Co.

HYDRAULIC EQUIPMENT

251—Pumps & Controls

Advantages and specifications of equipment for the oil hydraulic operation of industrial machinery are contained in 56-page booklet 5001. Included are pressure control, volume control, and directional control valves, as well as balanced vane type and axial piston type pumps, and hydraulic motors. Vickers, Inc.

PIPE, TUBING & HOSE

252—All-Purpose Fittings

Fittings designed to absorb shock and resist vibration are the subject of a 12-page bulletin. They are described as consisting of a compression nut, housing a synthetic rubber seal fixed to the tube by a metal ferrule. The design prevents metal contact between tube and fitting. Applications include use with metal tubing on all fuel, oil, water, air, and refrigerant lines in a broad range of temperature and pressure conditions. Specifications for female

(Continued on page 171)

Wanta pump something at lower cost?

CHECK HERE

Air	Dye Solutions	Latex	Salt Water
Alcohol	Edible Oils	Mash	Shortening
Ammonia	Ethane	Methane	Sludge
Beer	Fish Oils	Milk	Soap
Benzol	Formaldehyde	Molasses	Sodium Chloride Solution
Boiler Feed Water	Fresh Water	Naptha	Sodium Silicate
Brewer's Mash	Gas, Manufactured	Nitric Acid	Sodium Sulfate Solution
Butter	Gas, Natural	Nitrogen	Starch
Butane	Gasoline	Oil, Crude	Sulphuric Acid
Cane Syrup	Glucose	Oil, Refined	Sump Water
Calcium Carbonate Slurry	Glue	Oxygen	Sweet Water
Calcium Sulfate Slurry	Glycerine	Paint	Tomato Juice
Casein Solutions	Glycols	Potassium Hydroxide	Varnish
Cement Slurry	Hydrochloric Acid	Propane	Vinegar
Chocolate	Hydrofluoric Acid	Raw Boiler Feed Water	Viscose
CO_2 Gas	Ink	River Water—Dredging Operations	Water (various)
Crude Oil	Jam	Rosin	Wax
Dairy Products	Jelly		Whey
	Ketchup		
	Lacquer		

THIS list of fluids will give you a rough idea of the diversity of pumping jobs in which Darcova Pumcups are responsible for really *big* savings.

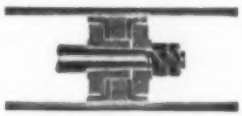
It boils down to the fact that Pumcups all but eliminate fluid slippage *throughout* their life span . . . and they *last many times as long as other packings.* Think of the down-time avoided, the production gains due to prolonged high efficiency, and the time-and-money-saving reduction in maintenance!

Years of application research have gone into the development of Pumcups. Made today in standard as well as many special compositions and textures for a wide range of temperature and pressure conditions, they offer you superior cost-cutting service in virtually *any* pumping job, simple or tough! And they're available in diameters from 1 to 20 inches.

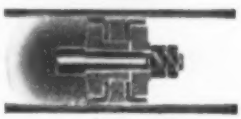
SEND FOR FREE BULLETIN

Why not weigh *all* the facts? Bulletin 4401 covers Darcova Pumcups for reciprocating pumps; Bulletin 4502 on Pumcups for air or hydraulic mechanisms. Write for yours today.

DIAGRAM OF DARCOVA PUMCUP ACTION (greatly exaggerated)



NORMAL: BOTH PUMCUPS RELAXED



UNDER PRESSURE: PUMCUPS SEAL AGAINST CYLINDER DESPITE WEAR, MINIMIZING SLIPPAGE

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT 9, PA.

DARCOVA
THE ORIGINAL COMPOSITION CUP

PUMCUPS

Cancer strikes 1 in 5

Strike back

Give

Your gifts to the American Cancer Society help guard those you love.

Your dollars support research in a hundred laboratories and universities . . . spread life-saving information . . . ease pain and suffering . . . provide facilities for treatment and care of cancer patients.

It is a sobering fact that cancer may strike anyone tomorrow: strike back today with a gift to the American Cancer Society. You may mail it, simply addressed CANCER, c/o your local post office.

American Cancer Society

new bulletins

(Continued from page 169)

connectors, unions, elbows, tees, and crosses are tabulated. Chicago Forging & Manufacturing Co.

253—Pipe & Tubing

One of the alloy tubing steels widely used in elevated temperature service is discussed in 4-page folder TDC-146. The mechanical properties of annealed and heat treated types, physical properties, and maximum allowable working pressures are tabulated. Fabrication also is discussed. Tubular Products Div., The Babcock & Wilcox Co.

254—Instrument Tubing

Three types of instrument tubing, described in a 4-page folder, consist of metallic tubing over which a coating of plastic has been extruded to prevent corrosion. In addition to single lines, several types of tubing harness containing 4, 7, 10, 14, or 19 tubes are described. Dekoron Tubing Div., Samuel Moore & Co.

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255—Plastic Pipe

Procedure for the installation of flexible plastic pipe is described in a technical data sheet. Various types of available fittings also are depicted. Answers to the most frequently asked questions present the reader with the most important facts concerning installation, application, and specifications. Carlon Products Corp.

256—Flexible Tubing

Several types of flexible tubing for ventilation, fume and dust removal, and materials handling are described in 8-page bulletin C2-4. Construction and advantages are discussed. A chart shows at a glance which type of tubing is best suited for each of a long list of industrial applications. Engineering data are given, including an air friction chart and a specifications table. Flexible Tubing Corp.

257—Welded Steel Pipe

Data contained in 42-page reference manual 3M should be of value to all pipe users. Tabulated in this booklet is information on fittings, field joints, protective coatings and types of fusion welded steel pipe for water, oil or gas from 4 to 36 in. diam. Such engineering data as a flow chart and tables of safe working pressures add to the publication's value. Southern Pipe & Casing Co.

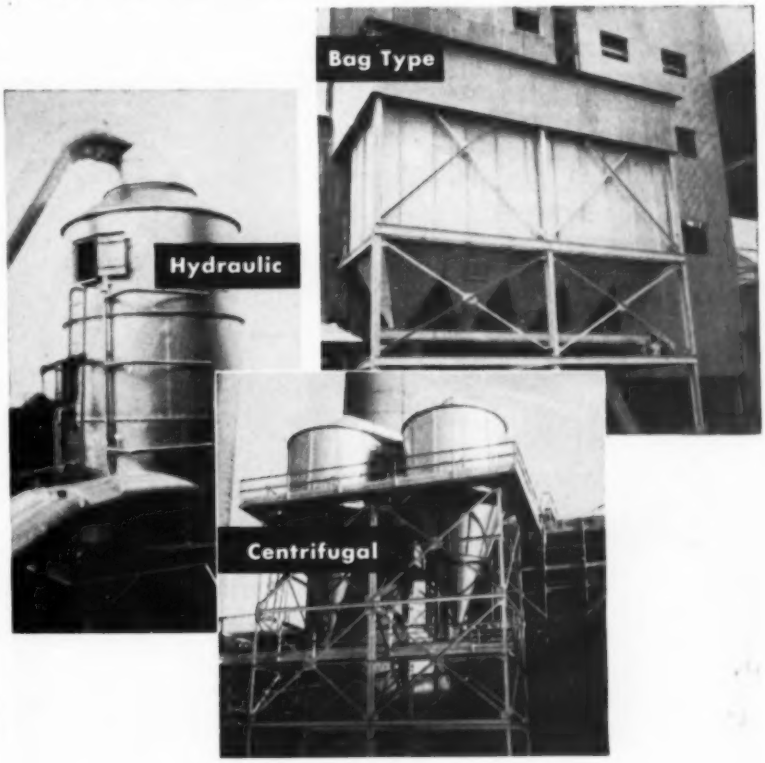
258—Insulated Pipe

Applications for pre-sealed insulated pipe, described in 4-page folder 6C, include underground and weather exposed piping systems conveying hot or cold liquids, gases and steam up to 1000 psi. The bulletin gives applications, special features, construction, fabrication and specifications. Durant Insulated Pipe Co.

(Continued on page 172)

Cancel the High Cost of Dust and Fume Damage with Norblo

engineered collection equipment . . .



and salvage valuable elements economically!

Dust and fume collection fits into processing and manufacturing *in a big way*. Norblo has helped to implement this valuable aid to safety, health and economy in a big way with outstanding developments in three principal types of collection — Centrifugal, Hydraulic and Bag systems.

Norblo Systems are making new records for high recovery with low operating and maintenance costs. High-efficiency equipment is engineered to include the correct factors to suit your needs and carries the Norblo guarantee of performance. Get the facts on Norblo Dust and Fume Collectors before you decide on any dust or fume collection equipment.

The Northern Blower Company

Engineered Dust Collection Systems for All Industries

6422 Barberton Ave. OLympic 1-1300 Cleveland 3, Ohio

new bulletins

(Continued from page 171)

PACKAGED STEAM GENERATORS

259—Oil & Gas Fired Units

Important features of a self-contained, completely equipped, steam generating unit are outlined in 8-page bulletin 508. Units are listed for oil, gas, or combination oil and gas firing. Installation is discussed, and typical examples are illustrated. Johnston Brothers, Inc.

PUMPS

260—Close-Coupled Pumps

Construction features of supporting adapter type, close-coupled general purpose pumps are described in 6-page folder 52B6083A. Units have capacities to 2500 gpm at heads to 550 ft. Alternate sealing arrangements are discussed, and principle dimensions are listed. Allis-Chalmers Manufacturing Co.

261—Reciprocating Pumps

Installation, operation and maintenance of reciprocating pumps is the subject of 20-page service manual 202. Useful conversion tables, technical data and general engineering information also are presented. Warren Steam Pump Co., Inc.

262—Rotary Pumps

Heavy duty rotary pumps are the subject of 16-page bulletin W-483-B2. Construction and specifications are given for herringbone gear types with capacities to 5000 gpm and pressures to 500 psi, and a sliding-vane type rated to 100 gpm and 200 psi. Fields of application are tabulated, and typical driving arrangements are shown. A useful data section includes a viscosity conversion table, the relation of A.P.I. hydrometer scale to specific gravity, and a viscosity-temperature chart for fuel oils. Reciprocating Pump Div., Worthington Corp.

THERMAL INSULATION

263—Insulation Surfacing

Fire-retardant surfacing, designed to provide maximum resistance to mechanical abuse regardless of the insulating materials used, is briefly described in a catalog sheet. Photos show actual use on ducts, pipes, and tanks. The material is designed to be used with lagging cloth. Benjamin Foster Co.

264—Insulation Specifications

Engineers who must specify thermal insulations in oil refineries and chemical process plants should find a useful source of quick reference in 52-page brochure IN-128A. Specifications are listed for thermal insulations on various types of equipment. Seven tables list recommendations for thickness. Also described is a complete service, including materials, engineering and application. Johns-Manville.

SOOT BLOWERS & TUBE CLEANERS

265—Automatic Soot Blowers

"Some Outstanding Automatic-Sequential Soot Blower Installations in Central Stations," 32-page bulletin 1004, discusses actual case histories. Power and reheat boilers with capacities to 1,370,000 lb per hr, pressures to 1925 psi, and temperatures to 1055 F are included. Blowing medium is steam or air, and units are power-driven by air or electric motor. Copes-Vulcan Div., Continental Foundry & Machine Co.

"JOHN CRANE" SUPER SEAL PLASTIC PACKING No. 1

Boiler plant operators of high speed centrifugal boiler feed pumps have long been looking for a satisfactory packing for these important units. Speeds have advanced from 1750 rpm. in 1910 to 5000 rpm. today, with shafts ranging up to 3½" diameter. Handling hot condensates up to 430°F. and pressures to 1250 psi. are no longer uncommon. High speed centrifugal boiler feed pumps go into service with lightning speed. The friction heats ordinary packing in a very short time. The oil and lubricants in these packings are boiled out and the asbestos seizes around the pump sleeves. Extensive damage and costly shutdowns result.

"JOHN CRANE" Super Seal Plastic Packing No. 1 is different!

This packing has a dry flake graphite lubricant. Every asbestos fiber is impregnated with graphite. The body of the packing is a combination of non-frictional metal particles. Asbestos fiber, graphite and rubber binder are semi-vulcanized as a mass, forming a resilient, flexible, non-frictional, strong packing.

"JOHN CRANE" Super Seal Plastic Packing No. 1 compresses satisfactorily under gland pressure to provide a perfect fit in the stuffing box. With proper lubrication, the packing runs cool and seals with minimum leakage. There is no lubrication to run out. The graphite surfaces polish the sleeve.

Operating engineers prefer "JOHN CRANE" Super Seal No. 1 for high speed centrifugal boiler pump service. Supplied in spirals, coils and die-formed rings and sets to fit all stuffing boxes.

Write today. Ask for our illustrated catalog. Crane Packing Co., 1831 Cuyler Ave., Chicago 13, Ill.

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MOTORS & GENERATORS

266—Motor Maintenance

Listed in 64-page general catalog 29 is equipment for the maintenance of commutators, motors, and electrical distribution systems. A brief description and useful information on each product is presented. In addition, products such as production equipment, safety equipment, and tools for mechanical maintenance are presented. Martindale Electric Co.

267—Motor Controls

"Quality Line of Motor Controls For All Industries," 28-page booklet, describes standard motor control apparatus including controls, starters, and accessories. Construction, advantages, and applications are listed. Allen-Bradley Co.

268—Drive Equipment

Auxiliary drive equipment for rolling mills is the subject of 12-page bulletin GEA-5570. Special emphasis is placed on

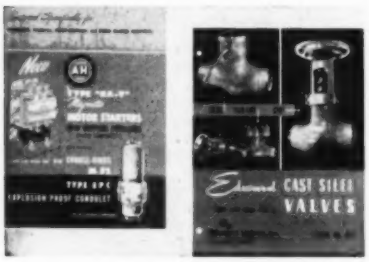
the importance of sound auxiliary drive systems in helping increase the tonnage of steel mills. Outstanding features of specific installations in blooming and slabbing mills, hot-strip mills, and cold-strip mills are described. Also discussed is the application of magnetic loop controls, tensiometers, x-ray thickness gages, and steel-mill width gages. General Electric Co.

269—Thyraton Motor Controls

How thyraton motor controls provide the stepless speed control of a d-c motor from a-c power is explained in 4-page folder GEA-5827. Component parts, operation and specifications of a precision controlled packaged drive for ¾ to 10 hp applications are discussed. General Electric Co.

270—Magnetic Motor Starters

Magnetic motor starters with vertical overloads below contactor are described in 8-page bulletin 4529-26. They are manufactured especially for petroleum, chemical, petro-chemical, and other related industries. Advantages and construction are discussed, and principal dimensions are listed. Industrial Control Div., The Arrow-Hart & Hegeman Electric Co.



VALVES

271—Cast Steel Valves

To aid engineers in the selection of valves, 56-page booklet 12-C contains useful information on material specifications, preparation of welding ends, flange facings, and pressure-temperature ratings. Construction and specifications for globe, angle, and check valves in 300, 600, 900, and 1500 lb pressure classes are given. Also discussed are parabolic disk valves for hand or motor control of volume. Edward Valves, Inc.

272—High Pressure Valves

Electrically operated high pressure valves, offered in sizes from ⅛ to 1½ in. and for pressures to 3000 psi, are the subject of a 4-page folder. Design, application, sizes and operation are discussed. Diagrams show circuits for normally closed and normally open operation. Atkomatic Valve Co.

273—Valves & Fittings

Described in 16-page catalog 801 are a series of valves and fittings designed expressly for service with anhydrous ammonia or other gases that are non-corrosive to steel. Descriptions and specifications are presented. Henry Valve Co.

274—Air Valves

Valves for operating single or double acting air and hydraulic cylinders, and air motors, are described in 16-page catalog 1000. Hand, foot, power, and solenoid operated models are listed in sizes from ⅛ to 1¼ in. Illustrations, operating and circuit diagrams, and specifications are presented. Ledeen Manufacturing Co.

275—Solenoid Pilot Valve

Advantages and construction features of solenoid pilot valves for handling air, vacuum, oil, water, and inert gases are contained in 4-page folder PB. Listed in a table are 2-way and 3-way units for normally closed or normally open operation, with orifice sizes from 1/16 to 1/8 in. for operation on 110, 220, or 440 v, 60 c current. Valvair Corp.

276—Diaphragm Motor Valves

Specifications of diaphragm motor valves for narrow band proportional control are tabulated in 4-page specification sheet 419-2. Such data as size, construction, body pressure range, connections, and complete mounting dimensions are presented. Industrial Div., Minneapolis-Honeywell Regulator Co.

277—Control Valves

Advantages of air power for high production equipment are summarized in 12-page brochure 101A. Integral pilot operated, remote controlled and direct operated control valves are described. Advantages, operation and available models of each are discussed. Cutaway views indicate air flow through the units. Ross Operating Valve Co.

278—Needle Valves

Specifications and dimensions of recently developed gland-type needle valves are tabulated in 4-page folder 568. Included in a list of applications are gages, by-passes, and fine regulation of gases and liquids. A wide selection of models are discussed. The Lunkenheimer Co.

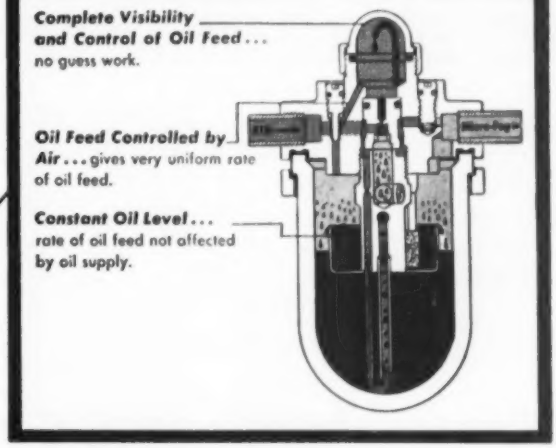
279—Regulating Valves

Specifications for internal pilot regulating valves for on-off control are contained in 4-page specification sheet 404-1. Details of construction for slip stem and rotary shaft types are shown. Engineering data

(Continued on page 174)

NOW

another new development in *Micro-Fog* lubrication by NORGREN


Complete Visibility and Control of Oil Feed... no guess work.
Oil Feed Controlled by Air... gives very uniform rate of oil feed.
Constant Oil Level... rate of oil feed not affected by oil supply.

for Bearings... Gear Chambers... Small Air Devices

This new Norgren Micro-Fog Lubricator is designed particularly for use where maximum oil fog is required with minimum air consumption.

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...TEMPERATURE INDICATION

3-way adjustable mounting

Auto-Lite offers many thermometer styles, permitting plant-wide temperature observation at low cost. Standard temperature ranges from minus 60°F to plus 750°F. Send for latest catalog showing various types.

Model F-1 temperature indicator—Rigid stem or capillary tubing for EYE-LEVEL remote reading. Priced from $22.

THE ELECTRIC AUTO-LITE COMPANY
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TOLEDO 1, OHIO
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TEMPERATURE INDICATORS & RECORDERS

Dollars fly away when your CHIMNEY is not efficient!

Have fuel costs mounted beyond reason? Do you have all the power you need at all times?

When new boilers have been added or power conditions increased, it frequently happens that the load on the chimney is built up to a point where the chimney no longer permits efficient operation...fuel costs mount, power lags and the whole plant suffers.

It is time to check on your chimney. A Consolidated Engineer will inspect your chimney at no inconvenience to you and make specific recommendations to lower your costs and increase operating efficiency.

This service places you under no obligation. Make use of it today.

Design - Construction
Linings - Waterproofing
Repairs - Aircraft Warnings - Lightning Rods
Demolition

225 ft. x 9 ft. Radial Brick Chimney, designed and built for State Hospital, Mt. Pleasant, Iowa.

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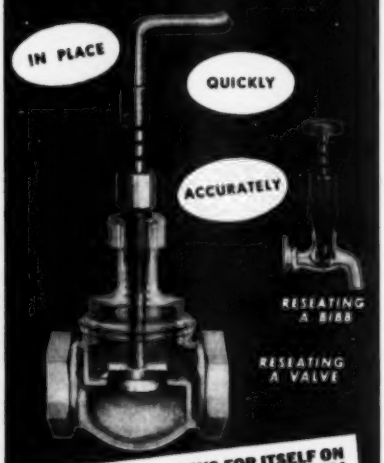
RESEAT VALVES AND BIBBS

IN PLACE
QUICKLY
ACCURATELY



PAYS FOR ITSELF ON FIRST 2 OR 3 JOBS!
Don't junk expensive globe or angle valves, bibbs, fixtures—reseat them! Order Skinner *Valve* and *Bibb Reseater*. Easy to use. Guaranteed cutters leave seat glass-smooth, level, tight.
1/4" to 2" $35.75
1/4" to 3" $49.50

M. B. SKINNER CO.
SOUTH BEND 21, INDIANA, U.S.A.

new bulletins

(Continued from page 173)

and mounting dimensions are tabulated. Industrial Div., Minneapolis-Honeywell Regulator Co.

TRANSFORMERS

280—Instrument Transformers

"Instrument Transformer Buyer's Guide", 102-pages, is designed to save time in selecting and ordering current transformers, potential transformers, and metering equipment. Ratings and ASA accuracy classifications are tabulated for indoor and outdoor units. Listings of ratio and phase-angle tests, together with tables covering the mechanical and thermal limits of current transformers, are included. General Electric Co.

WATER TREATMENT

281—Demineralizers

Construction of a single column, fully automatic demineralizer is discussed in a data sheet. Component parts and performance are described, and specifications are listed in a table. Penfield Manufacturing Co., Inc.

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282—Chemical Feeder

Construction and advantages of a heavy duty, positive displacement, diaphragm pump, designed to feed corrosive fluids used in industrial processes and in treating water and sewage, are discussed in 4-page folder 1201. A table lists a few of the chemical solutions and concentrations that can be handled. Operating data and a performance curve also are presented. % Proportioneers, Inc.%

283—Chemical Feeders

Tabulated in 8-page products index B-I-F 3 are chemical handling products of three manufacturers. Included are units for automatic treating, feeding, diluting, blending, proportioning, and sampling, as well as a wide variety of instruments for metering and controlling flow, liquid level, temperature, pressure, and weight. In addition, volumetric and gravimetric feeders for dry materials and feeding liquids by gravity are listed. A bulletin containing more complete details is listed for each product. B-I-F Industries, P.O. Box 1342, Providence 1, R. I.

284—Ion Exchange

"Demineralization Including Silica Removal by Ion Exchange," 28-page booklet 3803, has been prepared to help explain one of the newer roles that ion exchangers are playing in industry. Described are applications, principles of operation, design features, advantages, recommendations, and specifications for demineralizing and silica removal apparatus and synthetic resins. The Permutit Co.

285—Deaerating Heaters

Discussed in a report entitled "Experiences With Applications of Deaerating

Heaters in Feedwater Cycles," are many different methods of adapting such equipment to a wide range of conditions. Actual experiences in determining the most suitable size, type and design of heater for various plants are included. Flow charts, diagrams of selected designs and tabulations of results are employed. General explanations of the various types of equipment and their characteristics also are given. Graver Water Conditioning Co.

WELDING EQUIPMENT

286—Arc-Welding Accessories

Arc-welding accessories are described in 12-page booklet B-5451. Products vary from electrode holders and ground clamps to protective clothing and headgear. Specifications and illustrations are given, and special application characteristics are discussed. Westinghouse Electric Corp.

287—Stainless Steel Welding

Information on stainless steel wire for both automatic inert gas welding and manual gas welding, as well as metalizing, is contained in a folder. Descriptions of wire and equipment for welding of stainless steels are provided. Information on wire sizing, temper, spooling, tolerances, and equipment also is included. Alloy Metal Wire Co., Inc.

288—Welding Design

"How to Shape Steel for Low Costs," 6-page folder 843B, presents many useful ideas on the elements of welding design. Actual cost figures are presented with the examples to serve as a means of comparison. Engineering drawings supplement the text. The Lincoln Electric Co.

MISCELLANEOUS

289—Hardening Furnaces

Gas-fired, batch type hardening furnaces are the subject of 4-page folder SC-161. Direct-fired, horizontal hearth types and circular and rectangular salt pot types are included. Also shown is a line of controlled atmosphere equipment for hardening. A useful temperature conversion graph is presented. Surface Combustion Corp.

290—Shielding Rooms

Described in an 8-page brochure are rooms developed to suppress R-F interference caused by testing of electrical and electronic equipment. A variety of types and sizes are listed, including a double shield, multiple cell type, a double shield, isolated cell type, and a single shield type. Construction details and installation are discussed. Shielding, Inc.

291—Fluorescent Lamps

How to select the proper fluorescent lamp for a particular industrial or commercial application is explained in 24-page pocket catalog B-5799. Features and specifications for a wide variety of lamp types are presented, and a table provides convenient access to standard data on each type. Westinghouse Electric Corp.

—End

FALSTAFF CONSULTANTS

Brooke & Choporis, Consulting Engineers, Chicago, Ill., have pointed out that credit should be given to the architects and engineers connected with the program described in "Falstaff Goes from Old to New Without a Shutdown", February, 1953. Architects were Robert W. Layer, of Chicago and Philip P. Cazale, of New Orleans. Consulting Engineers were Brooke & Choporis.

Which butterfly valve better meets your needs?
In either of these or any other valves, manual or automatic, which W. S. Rockwell builds for your exact needs, you're sure to get the right type and size to best meet the conditions of operating pressure, temperature and nature of fluid handled, whether it be air, gases, water, liquid or semi-solid chemical materials.
It will pay you to learn how Rockwell Valves can meet your plant's flow control requirements.
Rockwell stainless steel valve; with air cylinder operator and valve positioner; for throttling gases at 1200° F.
Rockwell heavy duty valve for 50 p.s.i. working pressure; has a replaceable rubber liner for valve body and stainless steel blade; with a motor operator and handwheel declutching unit.
ROCKWELL Valves
Write for Valve Catalog
W. S. ROCKWELL COMPANY
BUTTERFLY VALVES • SLIDE VALVES • AUTOMATIC VALVES
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TRADE MARK REGISTERED

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NON-FLUID OIL is used and recommended by leading manufacturers of electric and air tools because they have learned through prolonged use and service tests over the years that NON-FLUID OIL enables portable tools to perform more efficiently over longer periods . . . no better proof of performance is possible.

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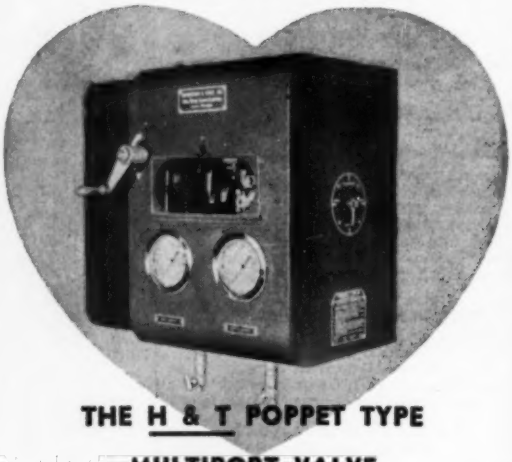

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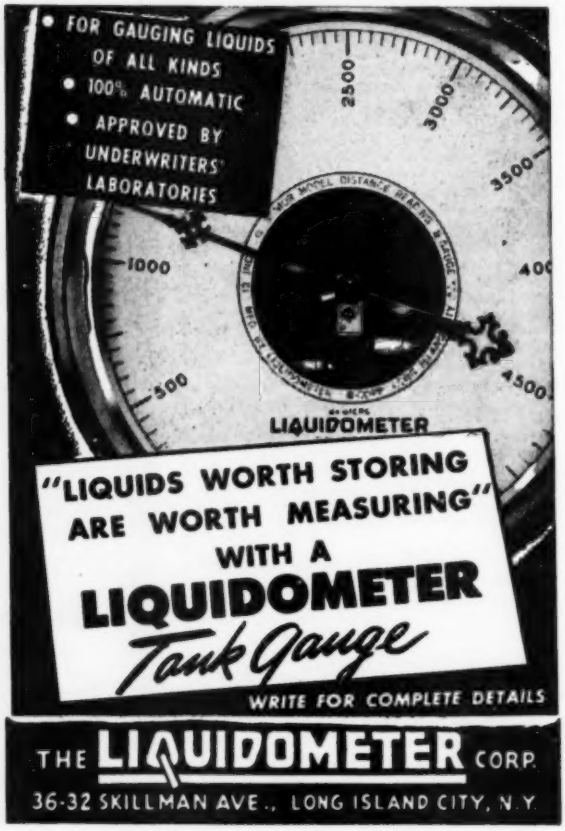

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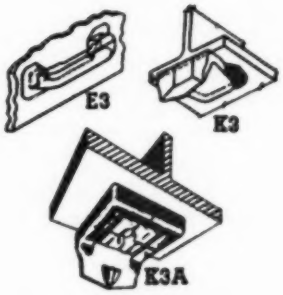

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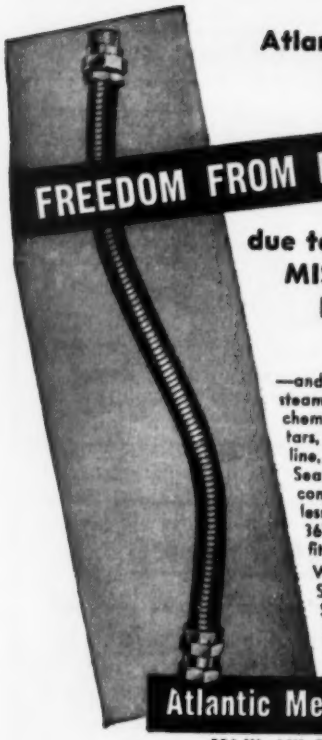

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for hand hole cover plate studs, etc...LEADING

BOILER MFRS. & USERS

now standardize on

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√ speeds up dis-assembly time!
√ prevents stud breakage!
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advertisers' index

Acme Electric Corp. 176
Aerotec Corp., The 142
Airetool Manufacturing Co. 168
Allis-Chalmers Mfg. Co. ....*
Alloy Steel Products Co., The ....*
American Blower Corp. ....*
American Brass Co., The American Metal Hose Branch ....*
American Engineering Co. ....*
American-Marsh Pumps, Inc. ....*
American Metal Hose Branch, The American Brass Co. ....*
American Water Softener Co. 152
Ames Iron Works 156
Anderson Co., The V. D. ....*
Armstrong Machine Works ....Second Cover
Atlantic Metal Hose Co. 178
Atlas Valve Co. 132
Aurora Pump Co. ....*

Babcock & Wilcox Co., The Refractories Div. 120
Baldwin-Hill Co. ....*
Barco Manufacturing Co. ....*
Beaumont-Birch Co. ....*
Beckman Inc., Arnold O. ....*
Belco Industrial Equipment Div., Inc. 139
Bell & Zoller Coal Co. 141
Betz, W. H. & L. D. 17
Bigelow Co., The 140
Bird Archer Co. 143
Bituminous Coal Institute 45
Blaw-Knox Co. 180
Boiler Engineering & Supply Co. ....*
Bowser, Inc. ....*
Buell Engineering Co., Inc. ....*
Builders-Providence, Inc. 126
Bussmann Mfg. Co. 14-15
Byers Co., A. M. 37
Byron Jackson Co., Pump Div. ....*

Cambridge Instrument Co., Inc. ..180
Canton Stoker Corp. ....*
Carborundum Co., The Refractories Div. ....*
Chapman Valve Mfg. Co., The ..138
Chelsea Fan & Blower Co., Inc. ..179
Chicago Metal Hose Div., Flexonics Corp. ....*
Chicago Pneumatic Tool Co. 46
Clarage Fan Co. ....*
Clark Bros. Co. ....*
Clark Mfg. Co., The ....*
Clayton Manufacturing Co. ....*
Cleaver-Brooks Co. 59
Clipper Mfg. Co., The ....*
Cochrane Corp. ....*
Coe Manufacturing Co. 155
Combustion Engineering Superheater, Inc. ....*
Consolidated Chimney Co. 174
Cook's Sons, Inc., Adam 158
Cooper-Bessemer Corp., The 38
Coppus Engineering Corp. 26-27
Crane Co. 7
Crane Packing Co. 172
Cuno Engineering Corp. 34

Darling Valve & Mfg. Co. 169
Dart Union Co. ....*
Davis Regulator Co. ....*
Dearborn Chemical Co. ....*
DeLaval Steam Turbine Co. 50
Detroit Stoker Co. 51
Diamond Power Specialty Co. 49
Dings Magnetic Separator Co. 130
Drew and Co., E. F. ....*
Durametallic Corp. ....*
Dutton Boiler Div., Hapman Dutton Co. 54

Eastern Gas & Fuel Associates ....*
Economy Fuse and Mfg. Co. 36
Economy Pumps, Inc., Div., C. H. Wheeler Mfg. Co. ....*
Edward Valves Inc., Subsidiary of Rockwell Mfg. Co. 30-31
Electric Auto-Lite Co., The 174
Elgin Softener Corp. ....*
Elliott Co. 22-23
Engineer Co., The 164
Erie City Iron Works 41
Everlasting Valve Co. ....*

Farris Flexible Valve Corp. 125
Felt Products Mfg. Co. 178
Fiske Bros. Refining Co., Lubriplate Div. ....*
Flexrock Co. 179
Flexonics Corp., Chicago Metal Hose Div. ....*
Foster Wheeler Corp. ....*
Foxboro Co., The 43
Fuller Co. ....*

Gallaher Co., The ....*
Gates Rubber Co., The ....*
General Coal Co ....*
General Electric Co. 18-19, 32-33
General Motors Corp., Hyatt Bearings Div. ....*
Gifford-Wood Co. ....*
B. F. Goodrich Co., The Industrial Products Div. 4
Goodyear Tire & Rubber Co., The ....*
Graver Water Conditioning Co. ..40
Greene, Tweed & Co. ....*
Grinnell Co. 57

Hammel-Dahl Co 39
Hapman-Dutton Co., Dutton Boiler Div. 54
Hartzell Propeller Fan Co. ....*
Hays Corp., The ....*
Helnemann Electric Co. ....*
Henszey Co. 161
Hilliard Corp., The ....*
Hills-McCanna Co. 144
Hoffman Specialty Mfg. Corp. ....*
Hungerford & Terry, Inc. 176
Hyatt Bearings Div., General Motors Corp. ....*

Ideal Industries, Inc. ....*
Illinois Engineering Co. Inc. ....*
Ingersoll-Rand Co. 53
International Nickel Co., Inc., The ....*
I-T-E Circuit Breaker Co. 10-11

Jeffrey Mfg. Co., The ....*
Jenkins Bros. 9
Jerguson Gage & Valve Co. ....*
Johns-Manville ....*
Johnston & Jennings Co., The ..29

Kaylo Div., Owens-Illinois Glass Co. ....*
Kewanee-Ross Corp. ....*
Key Co., The ....*
Kirk & Blum Mfg. Co., The 163
Klemp Metal Grating Corp. 145
Kuljian Corp., The ....*

Leslie Co. 123
Link Belt Co. 3
Liquidometer Corp., The 176
Lovejoy Flexible Coupling Co. ..160
Lubriplate Division, Fiske Bros. Refining Co. ....*

Magnatron, Inc. ....*
Manhattan Rubber Div., Raybestos Manhattan, Inc. ....*
Manzel, Inc. ....*
Marietta Concrete Corp., The ....*
Marcoid Corp., The 179
Milton Roy Co. 21
Murray Mfg. Co., D. J. ....*

National Aluminate Corp. 13
National Power Show 160
New Industries Committee ....*
New York Belting & Packing Co. ....*
New York & New Jersey Lubricant Co. 175
Niagara Blower Co. 154
Nicholson & Co., W. H. 161
Nordberg Mfg. Co., The ....*
Norgren Co., C. A. 173
Northern Blower Co., The 171

Orr & Sembower, Inc. 137
Owens-Illinois Glass Co., Kaylo Div. ....*

Patterson-Kelley Co., Inc., The ....*
Penfield Manufacturing Co. ....*
Pennsylvania Flexible Metallic Tubing Co., Inc. ....*
Permutit Co. ....*
Petro Div. ....*
Pick Manufacturing 134
Powers Regulator Co., The ...128, 129
Preferred Utilities Mfg. Corp. ....*

* means that the advertisement does not appear in this issue, but appeared in one or both of the two previous issues.

advertisers' index

%Proportioneers, Inc.% 35
Prote Tools 6
Pulverizing Machinery Co. ..... *

Raybestos Manhattan, Inc. Manhattan Rubber Div. ..... *
Raybestos Manhattan, Inc. Packing Div. 56
Refractory & Insulation Corp. ...151
Research Corp. ..... *
Ric-wil Co., The 133
Riley Stoker Corp. ..... *
Rockwell Co., W. S. 175
Rockwell Manufacturing Co., Edward Valves, Inc., Sub. ..... *
Rohm & Haas Co., Resinous Products Div., The ... *
Rotary Concrete Drill Co. 161
Rust-Oleum Corp. 135

Sarco Co., Inc. ..... Third Cover
Schneible Co., Claude B. ..... *
Schramm, Inc. 166
Sims Pump Valve Co., Inc. 180
Sinclair Refining Co. 131
Skinner Co., M. B. 174
Smooth-On Mfg. Co. 180
Snap-On Tools Corp. 167
Southern Coal Co., Inc. ..... *
Spence Engineering Co., Inc. 44
Standard Oil Co. (Indiana) 55
Standard Pressed Steel Co. ..... *
Strong, Carlisle and Hammond Co. ..... *
Sun Oil Co. 117
Superior Combustion Industries, Inc. 146
Syntron Co. ..... *

Taylor and Co., W. A. ..... *
Terry Steam Turbine Co., The ... *
Texas Co., The ..... Fourth Cover
Thermix Corp., The ..... *
Toledo Pipe Threading Machine Co., The 165
Trane Co., The 52

United States Gasket Co. 150
Universal Atlas Cement Co. 48
U. S. Electrical Motors, Inc. 176
U. S Hoffman Machinery Corp. ..133

Vogt Machine Co., Henry 42

Weinmann Pump Mfg. Co., The .. *
Western Precipitation Corp. 157
Westinghouse Electric Corp. .... *
Weston Electrical Instrument Corp. ..... *
Wheeler Mfg. Co., C. H. Economy Pumps, Inc., A Div. .. *
Wickes Boiler Co., The 25
Wiedeke Co., The Gustav ..... *
Wiegand Co., Edwin L. ..... *
Williams Gauge Co., The ..... *
Wilson, Inc., Thomas C. ..... *
Winslow Engineering Co. ..... *
Wing Mfg Co., L. J. 153
Worthington Corp. Engine Div. ..... *
Centrifugal Pump Div. 118-119
Compressor Div. 61
Feedwater Heaters & Deaerators Div. 60
Multi-V Drive Sales Div. ..... *
Steam Power Div. ..... *
Steam Turbine Div. ..... *
Vertical Turbine Div. 127
Water Treating Div. 58
Wright-Austin Co. ..... *

Yarnall-Waring Co. 62, 67
York-Shipley, Inc. ..... *

Zink Co., John ..... *

* means that the advertisement does not appear in this issue, but appeared in one or both of the two previous issues.

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DA-400

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Equipped with calibrated dial and outside adjustments—Ranges 0-30 psi to 300-2500 psi—The Mercoid magnet operated mercury switches are not affected by harmful effects of dust, dirt, or corrosion—your assurance of millions of operations.

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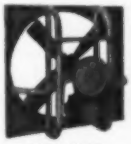
TYPE PLF EXHAUST FAN

TYPE PLDX DUCT BOOSTER



TYPE PLBD PRESSURE FAN

TYPE PLDU AIR BLASTER

FOR HAZARDOUS LOCATIONS USE-
CHELSEA
EXPLOSION-PROOF
FANS

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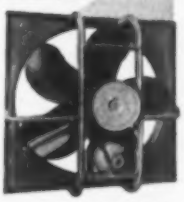
Always Buy Chelsea

Performance - proven CHELSEA explosion-proof fans meet rigid ventilating and exhaust specifications to the letter. For hazardous locations, specify CHELSEA type fans supplied with Class I, Group D motors, and non-ferrous, non-sparking propellers. Ask CHELSEA for recommendations for your particular processing or industrial need.



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Write for Catalog No. 400 address Dept. T-3.

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CONCRETE FLOOR PATCH

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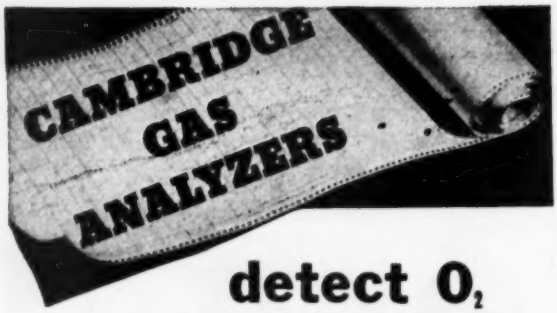

detect O_2 in FEED WATER

Continuous records of the oxygen dissolved in boiler feed water and of the hydrogen entrained in steam, indicate when corrective measures are necessary to prevent otherwise unsuspected and costly corrosion. Cambridge Analyzers measure and record dissolved oxygen directly. The hydrogen in the steam is measured and indicates the quality of oxygen set free by dissociation. Cambridge Instruments are available for continuously recording either O_2 or H_2 separately, or O_2 and H_2 simultaneously.

Send for Bulletin 148 B.P.

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3060 Grand Central Terminal, New York 17, N. Y.

Pioneer Manufacturers Of Precision Instruments

A—Deep crack. B—Tamping Smooth-On in. C—Crack completely sealed.

If You've Never Used SMOOTH-ON, *read this:*

Smooth-On No. 1 Iron Cement is a metallic powder which you mix with water to the consistency of putty. You tamp it, while still soft, into a crack or hole, making sure to force it against all surfaces. With Smooth-On you don't need to use heat or special gadgets. As it hardens, it expands slightly, clinging tightly in place. The required part is ready for use as soon as Smooth-On sets hard. Keep Smooth-On handy for both emergency and routine maintenance repairs. Buy it in 7 oz., 1 lb., 5 lb., 20 lb., or 100 lb. sizes. If your supply house hasn't Smooth-On No. 1, write us.

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THE IRON REPAIR CEMENT OF MANY USES

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in the Front Rank of Industry
ON ALL 5 COUNTS

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LONG LIFE • CLEANNESS
SAFETY

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BLAW-KNOX EQUIPMENT DIVISION
BLAW-KNOX COMPANY
Pittsburgh 22, Pa.
2072 Farmers Bank Bldg.

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HOW YOU CAN MAKE PUMP REPAIRS EASIER

Worn seats and valve discs, broken springs and stems are eliminated with Sims Pump Valves. Sims valves cure frequent pump repair headaches with exclusive design features. They're **guaranteed** to give you better pump performance.

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Write for new catalog showing how Sims valves fit your pump and give better pump performance.

SIMS PUMP **VALVE CO., INC.**

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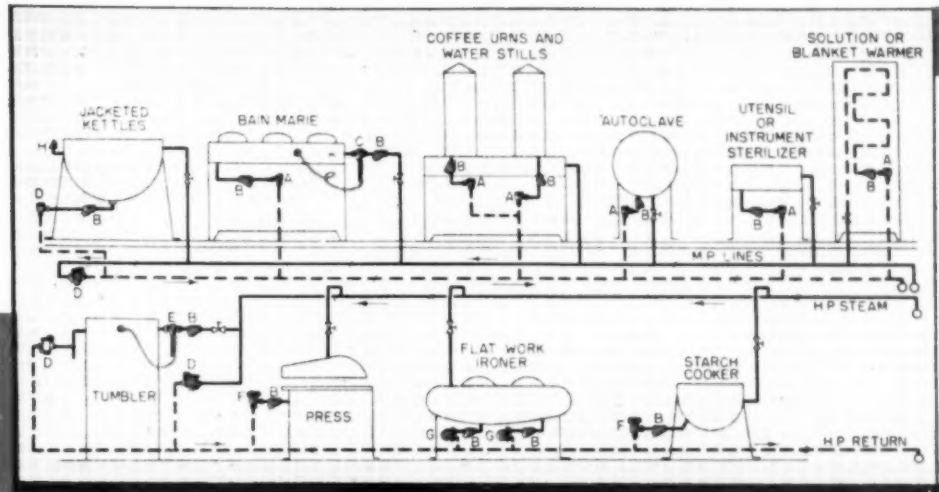

Series 52 No. 23

- *A* — S-65 Trap
- *B* — Strainer
- *C* — TR-19 Control
- *D* — Inverted Bucket Trap
- *E* — KR-14-MD Control
- *F* — 9-125 Trap
- *G* — Float Thermostatic Trap
- *H* — Air Vent

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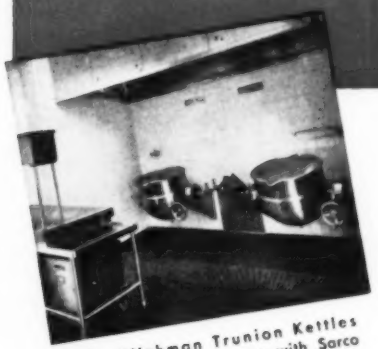
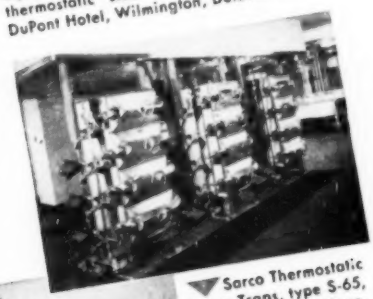


S. Blickman Trunion Kettles equipped by manufacturer with Sarco thermostatic steam traps, type S-65, DuPont Hotel, Wilmington, Delaware.



Sarco Thermostatic Steam Traps, type S-65, on S. Blickman Vegetable Steamers at Prudential Insurance Co., Newark, N. J.

Sarco Inverted Bucket Steam Traps on large size jacketed kettles by Legion Utensil Co.

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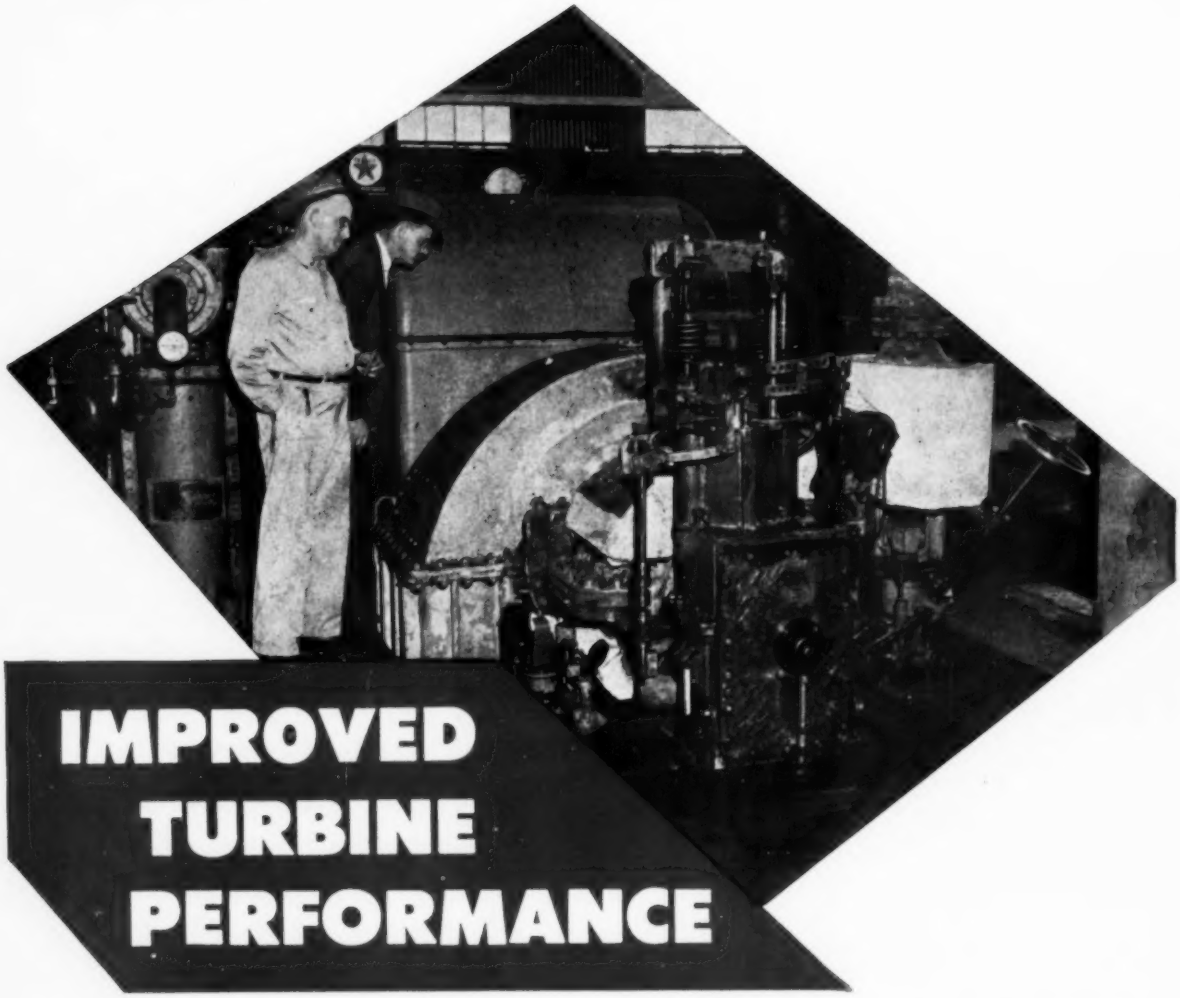

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